A VOLUME IN **RESEARCH IN MANAGEMENT EDUCATION AND DEVELOPMENT**

MANAGEMENT AND BUSINESS EDUCATION IN THE TIME OF ARTIFICIAL INTELLIGENCE

The Need to Rethink, Retrain, and Redesign

edited by

AGATA STACHOWICZ-STANUSCH

WOLFGANG AMANN

Management and Business Education in the Time of Artificial Intelligence

A volume in
Research in Management Education and Development
Agata Stachowicz-Stanusch, Wolfgang Amann,
and Hamid H. Kazeroony, *Series Editors*

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INFORMATION AGE PUBLISHING, INC.

Charlotte, NC • www.infoagepub.com

Library of Congress Cataloging-in-Publication Data

A CIP record for this book is available from the Library of Congress
http://www.loc.gov

ISBN: 978-1-64113-809-3 (Paperback)
978-1-64113-810-9 (Hardcover)
978-1-64113-811-6 (eBook)

Printed in the United States of America

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PART I

INTRODUCTION

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CHAPTER 1

THE TIME OF ARTIFICIAL INTELLIGENCE IN MANAGEMENT EDUCATION

What We Should Teach, How We Should Teach, and Where We Should Teach?

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Success in creating AI would be the biggest event in human history. Unfortunately, it might also be the last, unless we learn how to avoid the risks. The thing that's going to make artificial intelligence so powerful is its ability to learn, and the way AI learns is to look at human culture.

—Stephen Hawking

In June 2012, we celebrated the hundredth anniversary of Alan Turing, creator of the famous Turing test which is a test of a machine's ability to exhibit intelligent behavior. In September 2011, Cleverbot, the chatbot passed the Turing test.

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We may expect that

- by 2030, some 800 million jobs will have disappeared and taken over by machines;
- in 2019, half a billion users will save 2 hours a day as a result of AI-powered tools;
- by 2020, AI will be a top 5 investment priority for more than 30% of CIOs;
- AI technologies will be in almost every new software product by 2020; and
- AI will reach human levels by around 2029. Follow that out further to say, by 2045, we will have multiplied the intelligence, the human biological machine intelligence of our civilization a billion-fold (Gartner, 2017).

In 2016, Stanford University published the report "Artificial Intelligence and Life in 2030," exploring the role of AI in various aspects of society. Talking about education and learning, the report stated that AI will play a fundamental role (Stanford University, 2016).

John McCarthy first coined the term *artificial intelligence* (AI) in 1956 and at that time, the researchers came together to clarify and develop the concepts around "thinking machines." In the English Oxford Living Dictionary, we find the following definition: "The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages" (Artificial Intelligence, n.d.). Generally, AI is "concerned with the development of computers able to engage in human-like thought processes such as learning, reasoning, and self-correction" (Kok et al., 2002) and tries to imitate intelligent behavior by means of computer programs, that is, thinking and acting like humans, as well as thinking and acting rationally (Kok et al., 2002).

Artificial intelligence technologies are one of the top investment priorities in these days. They are aimed at finding applications in fields of special value for humans, including education. The fourth industrial revolution will replace not only human hands but also human brains, the time of machines requires new forms of work and new ways of business education, however we must be aware that if there is no control of human-chatbot interaction, there is a risk of losing sight of this interaction's goal. First, it is important to get people to truly understand AI systems, to intentionally participate in their use, as well as to build their trust, because "the measure of success for AI applications is the value they create for human lives" (Stanford University, 2016, p. 33). Consequently, society needs to adapt to

AI applications if it is to extend its benefits and mitigate the inevitable errors and failures. This is why it is highly recommended to create new AI-powered tools for education that are the result of cooperation between AI researchers and humanities' and social sciences' researchers, who can identify cognitive processes and human behaviors.

So we have put 4 main questions in our book: "How will AI impact the business world?"; "What should we teach?" (What is the "right" set of future skills?); "How should we teach?" (the way in which schools should teach and assess them); and "Where should we teach?" (What implications does AI have for today's education infrastructure?).

This volume is a collection of ideas, examples, and solutions on how machines, robots, and AI will affect business and management education.

The book is organized under two themes. Theme I (Part II), "Impact of Machines, Robots, and Artificial Intelligence on Business and Management Education" opens with Ünsal Sığrı and Gamze Guner's chapter, "Artificial Intelligence in Business Management Education and Research." The authors show that AI, which is the most talked about, the most discussed and researched system of superior technology, needs to be integrated as soon as possible for the use of business management education and research to keep up in this area. It is necessary to educate thousands of young people in the methods and techniques of scientific futures by requiring strong, new utopian and anti-utopian concepts instead of management education and research within the old paradigms. We need to adapt to the changing speed and try to capture the most accurate images of future opportunities. It can be seen that the management education and research which can be the most suitable to the speed of today can only occur by using artificial intelligence.

In the next chapter, "Artificial Intelligence: From Business Schools to Management Schools," P. Jaime Barrera, M. Rafael Bautista, and C. Gustavo Gonzalez start from the assumption that the incidence of all forms of AI that may have a significant impact—especially in what concerns education—will bring with it a mixed bag of positive and negative outcomes. Much of what comes depend on choices that must be made soon, and those choices must be based on some clarifying vision about how the human-AI interaction will affect aspects such as how we work and learn. This exercise is particularly relevant in any speculations about the future role of the university. It is the contention of the authors that its role, up to the present, as conveyor for certain forms of knowledge and learning, and as a source of new knowledge, falls short of what will be needed. Universities will have to help students increase the powers of facets of the human mind that are often taken for granted. In this chapter the focus is the power of insight.

One of the distinguishing features of the human mind is “insight.” Seeking and gaining “insight” is a fundamental function of intelligent behavior. Insight is the lens through which the authors of this chapter draw a comparison between human and AI. The approach followed consists of decomposing ”insight” in terms of five characteristics proposed by Bernard Lonergan, so as to provide grounds to develop a stance on AI’s possibilities and restrictions.

Subsequently, Gerrit Anton de Waal, John Thangarajah, and Adela J. McMurray in the chapter, “Artificial Intelligence and Frugal Innovation: A Formidable Alliance in Future Education,” identify how AI can enable and enhance frugal innovation (FI) to deliver cost-effective solutions to potentially billions of people, in particular those at the base and middle of the income pyramid. In layman’s terms, FI is when companies innovate throughout the entire value chain to develop products or services for customers who either cannot afford the current premium offerings and/or do not desire its unwanted features. The end result is offerings characterized by a substantial reduction in price and/or total cost of ownership/usage, a focus on core functionalities, and optimization of performance level to meet the exact needs of target users.

A key motivator in developing AI technology, where machines perform human-level, cognitive functions, is to extend human capabilities and improve the quality of life. Through a number of case studies from a diverse range of industries this article demonstrates how AI is helping frugal innovators to develop solutions that were previously not available or affordable to disadvantaged people. From this it is speculated on how the AI/FI partnership could potentially influence the development of cultures specific to education and training, in particular focusing on end users that are constrained in physical or financial ways.

Peter Yeoh, in his chapter named “The case for Inclusion of AI Governance in Business Management Education,” shows how AI applications are impacting daily living, business, education, and the public sector in profoundly significant ways; some good, but some bad. There are growing concerns that current and potential deployments of AI systems could induce various governance issues. Such matters are of major interest to business education, especially following the aftermath of the 2008 global financial crisis. This chapter seeks to explain the why, what, and how of AI governance learning in management education with focus on such developments in the United States and the United Kingdom. It also provides various proposals for the future.

Antti Ainamo, Paula Lehto, and Jaakko Porokuokka close this part with their chapter “Robots and AI as Ways to Integrate Education and Work Life.” In this chapter, authors present the result of the research project called ROSE. In educating students for work and a career in the health and well-being sector, the traditional strategy has been "learning by rote," that is, educators have students read textbooks and listen to the educator talking at a podium in a lecture room. Sometimes, to buttress the reading and listening, students are put to work on exercises that illustrate the learning in the books and lectures. Yet, challenging this traditional model, for some time now, is what the Nobel Laureate, Herbert Simon (1996), has called "learning by doing," that is, learning in ways that are much like the work life for which the students are being educated. To explore and help specify in what ways, how, why, and for whom the model of learning by doing appears most promising, we report in this chapter on our learnings as educators as part of a research project called ROSE, an acronym for Robots and the Future of Welfare Services (ROSE, 2018).[1] As part of ROSE, we began with students who co-created with service staff, at a senior citizens' group home, services to be delivered by a social robot to these senior citizens.

The second theme (Part III), "Teaching Skills That Machines and Robots Cannot Do: The Challenge for Business and Management Education" opens with the chapter: "How Can We Reinvent Business Education? Applying the Professional Service Life-Cycle Perspective to AI-Enabled Learning" by Jie J. Zhang and Benjamin Lawrence. This chapter applies the life-cycle perspective of professional service work (Lawrence, Zhang, & Heineke, 2016) to understand the collaborative processes between advanced technologies and human service providers in the context of AI-enabled education. We developed the professional service life cycle (PSLC) model from an in-depth longitudinal case study of the evolution of consulting services for the Leadership in Energy & Environmental Design (LEED) certification. Our PSLC model explains the tensions and dynamics of a collaborative service system consisting of both technological and human education resources, offering insights on how to promote and manage such systems efficiently and effectively. Each of the four life stages in PSLC (i.e., innovation, validation, diffusion, and commodification) and transitions yield important insights related to rethinking, retraining, and redesigning business education in the age of AI. The life-cycle perspective helps us understand profound shifts in employment, changes in learners' needs, and the dynamic educational processes that bridge the two, thus shining light on educational services innovations that provide lifelong learners with personalized yet cost-effective, experiential learning opportunities. We outline a framework that elucidates the evolving roles that education providers and AI-based services will play in reaction to various market forces and consumer demands.

In the subsequent chapter "Deconstructed Education: The Usefulness of Smart Teaching" Davide de Gennaro, Andrea Tomo, and Lucio Todisco argue that teaching must include innovative methods in order to improve the quality of students' education and motivation for learning. This study focuses on the benefits that innovative teaching systems can generate for learning, especially with reference to distance teaching tools, the so-called smart teaching, with the aim of identifying the main contributions on the topic and summarizing their merits and defects, in the treatment of such a fashionable and interesting topic. Implications for theory and practice are discussed.

James F. Fairbank, William E. Spangler, and Bonnie Morris in their chapter, "Educating Business Students for the Age of Intelligent Machines: A Framework for Online AI-Enabled Learning" present an online learning framework that uses AI modules to facilitate experiential learning and prepare business students to compete in a world increasingly dominated by intelligent machines.

Focusing on collaborative human-AI problem-solving, their framework incorporates experienced instructor judgement to mediate the learning relationship between the student and various AI tools, thereby helping students develop specific skills that reflect the emerging human–machine partnership required to solve real-world problems and make better informed decisions.

They illustrate this by describing a detailed case within the learning context of an auditing task, which is emblematic of a class of business problems that require professional judgment and decision making to evaluate the quality of a process or system. Although they use a specific accounting task to illustrate the use of their framework, their framework is generalizable to many current and future applications of AI in business education more broadly.

The next chapter "Artificial Intelligence and Executive Development" is written by Danica Purg and Arnold Walravens. In this chapter, they claim that AI has a disruptive impact on our way of life. No matter what exactly will happen, it is obvious that AI will also impact the position and role of business schools. In this chapter, we shall focus on AI and executive education, on management and leadership development, on AI, and the content and methodology of teaching and learning.

Managers and leaders are and will be confronted with an environment, where new jobs and professions will go through big changes, and their own position will also be under continuous change. It will be the task of business schools to assist managers and leaders in finding their way in their complex, often chaotic environment. The complexity is particularly caused by the overwhelming and continuously growing quantity of available data. Business leaders will have to be able to select from this mass of numbers so as to outline the future route of their organizations.

Therefore the challenging questions for a business school is how to develop capabilities amongst business leaders to deal with this phenomena, to be capable of being aware of it, to analyze the data, and to have a creative mindset to discover in the data the hidden links for the future. The demand for different capabilities of business leaders will result in a different content of education and learning and a new composition of faculty.

In the next chapter, "When Artificial Intelligence Meets Augmented Reality: Implications for Management and Business Education," Nakul Gupta and N. P. Singh notice that agile business school education is a new variation on business school pedagogy that combines traditional-style education with technology to provide education that's relevant today and will be relevant in dealing with the unforeseen tomorrow. With the help of the model proposed by Gupta and Singh in their chapter, the business schools can create leaders and managers that are well equipped with skills and abilities not only for today's business challenges but also for tomorrow's business uncertainties. The conceptual model proposed in the chapter is comprised of three sub-paradigms viz emerging information and communication technologies, realms of experience, and education agility. These three sub-paradigms help in knitting together a conceptual proposition that augments management school education experience in contemporary times. The model further has AI and augmented reality as its essential components. AI combines "almost human level" intelligence and logical deductions with fast computing speeds. This helps in gauging and responding to needs of learners at an enormous scale in both offline and online environments. Augmented reality (AR) on the other hand combines human senses (such as sight, sound, taste, smell, touch) into a technologically driven experience.

Kathryn Woods closes the book with her chapter: "Artificial Intelligence and the Learning Experience: The Impact of Augmented and Virtual Reality on Teaching and Learning." In this chapter, she notices that the increasing presence of two subsets of AI known as augmented reality and virtual reality have created an opportunity for educators to consider new methods of delivering course material to provide a more robust experience for students. In this chapter, readers will find an overview of the impact of augmented and virtual reality on the way business is conducted, the opportunities and challenges in incorporating augmented and virtual reality into classroom instruction, descriptions of vignettes that are designed to assist instructors in incorporating AI into the learning environment, and descriptions of best practices in this area. The opportunities identified include participating in virtual worlds, various methods of incorporating augmented reality apps and textbook features into assignments, and taking virtual field trips. The challenges identified mostly derived from a scarcity of resources. Best practices for faculty who would like to include these technologies in their instructional methods included intentional implementation, adapting current tools and practices, and finding creative ways to stay informed about new directions for augmented and virtual reality within one's own discipline.

This book is authored by a range of international experts with a diversity of backgrounds and perspectives, hopefully, bringing us closer to the responses for the questions: "What should we teach?" (What is the "right" set of future skills?), "How should we teach?" (the way in which schools should teach and assess them), and "Where should we teach?" (What implications does AI have for today's education infrastructure?). We must remember as we have already noticed before: "Education institutions would need to ensure that they have an appropriate infrastructure, as well as the safety and credibility of AI-based systems. Ultimately, the law and policies need to adjust to the rapid pace of AI development, because the formal responsibility for appropriate learning outcomes will in future be divided between a teacher and a machine. Above all, we should ensure that AI respect human and civil rights" (Stachowicz-Stanusch & Amann, 2018).

NOTE

1. cf. https://www.tuni.fi/en/research/rose-robots-and-future-welfare-services

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PART II

IMPACT OF MACHINES, ROBOTS, AND ARTIFICIAL INTELLIGENCE ON BUSINESS AND MANAGEMENT EDUCATION

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CHAPTER 2

ARTIFICIAL INTELLIGENCE IN BUSINESS MANAGEMENT EDUCATION AND RESEARCH

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When we look at the business and management periods that Alvin Toffler (1982) mentioned in his book, *The Third Wave*, the first wave—is a period of intense work, such as people producing for themselves. With the second wave of industrialization people began producing for others. After Toffler's first and second waves, a third wave of computer and information age with the beginning of today's artificial intelligence period was reached (Toffler, 1982). The age of artificial intelligence, that is, the fourth wave, as in the other periods, was born and coordinated in the coming period. The fourth era of the mentioned computer age has to start with a new period; positive and developing aspects should be seen. In retrospect, people feared the birth of the computer or even the emergence of industry in the past and

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wrote bad scenarios. It is true that the empty side of the glass is the bad and scary side.

However, to look at the other side, in 2020, it is predicted that artificial intelligence (AI) will be able to reach the human level by reaching the parts that cannot be explored in the human mind, transferring the difficulties in education and training, learning, accurate measurement, and transferring each information to the students in a way that will provide development. Maybe not only help, but it can eliminate this problem completely. Although artificial intelligence appears to be a scary word for not being a part of ourselves . . . in business world, Al can help start-up companies reduce risk

- by helping them start within a specific standard;
- by publishing East analysis reports, it can prevent losses and bankruptcies due to excessive market value;
- by eliminating problems in business management; and
- by removing problems from running rampant in the enterprise.

In order for artificial intelligence to be able to help change management and business education positively as we live in all other periods—industry, computer, and information age—artificial intelligence must first enter the Academy in the field of business and management. We can start our education system with a chapter under the heading "Management With Artificial Intelligence" or "Artificial Intelligence in Business Management"—and start by giving information about how artificial intelligence is at work and where it is in business today and where it is predicted in the future. For example, in research methods, we can develop a data collection technique using virtual reality under "artificial intelligence data collection" technique in order to make up for the lack of qualitative and quantitative data analysis and to express the expressions that cannot be expressed or different from oneself.

In this section, the use of artificial and business management training, business life and education, and the limited aspects of artificial intelligence are brought under the headings of the study. After the details of the sections, the discussion section is included and the section is finalized with results and suggestions.

ARTIFICIAL INTELLIGENCE AND BUSINESS MANAGEMENT EDUCATION

Artificial intelligence (AI) is a computer science discipline that addresses the simulation of intelligent human behavior through computers, in the sense of learning that human intervention is minimal (Russell & Norning, 2009). As an equivalent to human intelligence, Wang divides the definition of artificial intelligence into five categories:

1. Structurally, it assumes that Al can provide by construction similar to human brain structure consisting of large neuron processing units that run parallel to the human brain.
2. According to the behavior, it is better to concentrate on the behavior of the system when evaluating intelligence.
3. According to the ability, intelligence is thought to have the ability to solve difficult problems. For example, it means that a person can solve problems.

   In this context, if a computer can do the same thing as humans they are called smart. Similarly, there are expert systems for various applications of AI. Experts are intelligent, so a computer can only be smart if it can solve a problem that the expert can do.
4. Functionally, many AI researchers prefer to represent the ability of a representative to describe a computer program as a function that maps input (perceptions) to output (actions) because it is a computer scientist or engineer.
5. In principle, it is the basic principle that AI researchers try to define the reason that human intelligence can be explained and reproduced on a general level in the computer environment because of the desire of science to search simple and unified explanations of complex and various phenomena. According to these five principles, Wang argues that AI is a human-centered approach, and that human thoughts are the result of abstraction (Wang, 2008).

In the article published by McCarthy, Minsky, Rochester, and Shannon in 1955/2006, the concept of AI is suggested as a study. The proposed study is based on the assumption that every aspect of learning or other characteristics of intelligence can be described as precisely as a machine to simulate as a principle. In this article, he mentions how machines use language, how to create abstracts and concepts, and to make an attempt to find out how they can solve problems for people and how they can improve themselves.

In 1955, McCarthy suggested that 2 months of AI study should be carried out at Dartmouth College in Hanover, New Hampshire. It was suggested that the problems mentioned above could be solved by a group of carefully selected scientists working together (McCarthy et al., 1955/2006). McCarthy and his colleagues are among the first to develop AI by developing a machine, programing an automated calculator, programing a computer using a language, creating a network of neurons, a self-expanding machine, and the concepts of random and creativity. Studies on AI, one of the newest fields in science and engineering, became known in 1956 in articles and studies (Russell & Norning, 2009).

In 1970, the most striking event of the period as the date of the computer is the chess event of Greenblatt. Richard Greenblatt, a renowned star actor known as the first guide to AI research, began with Rand's old computer expert Hubert L. Dreyfus defeating his computer in a soft play. Dreyfus, who defended the idea of machines, lost the game in the computer environment and has created a striking effect for the period (Toffler, 1970). Artificial intelligence, which started as an assumption in 1955, continued to develop as an artificial operating system with high cognitive functions or autonomous behaviors.

EDUCATION AND THE BUSINESS WORLD OF ARTIFICIAL INTELLIGENCE

Toffler (1970), who has divided human history into hundred-year chapters, emphasized that during this century people spent 65% of their life span in a cave and the remaining 35% showed a rapid development. Toffler argued that technological developments were rapidly increasing with the beginning of the industrial revolution and that development could continue in the future. In addition, He predicted how a biological computer could be built after learning about how the human brain works. In 1970, the matching of the biological structure of the human brain with the computer structure has been the precursor of today. He, who argues that future computers will be the biological elements of human brains, has emphasized that it is wrong to consider technological progress as a normal extension of the known, and the lack of imagination has said that when it comes to technological developments, it is just an act of seeing today as an act and an economic tool (Toffler, 1970). He thought that the use of AI in today's management education is not widespread because the imagination cannot develop in this area. However, this seems to occur in the field of management education. The use of AI in other areas of education is much more common. Significant performance, effectiveness, and effectiveness breakthroughs have been created through the development of AI applications, improved availability of data sets, increased computing power, and advances in learning algorithms. Especially in the last 5 years, AI techniques, known as deep learning, provide a fast developing performance in image recognition, subtitle creation, and speech recognition. Artificial intelligence, however, is a system that is intensely popular in many areas, including education, which can quickly pass to the application phase starting with an experimental stage. Artificial intelligence, which has been used in language learning in the field of education, has become a structure that is thought to be used in all other fields of education. Nowadays, as a result of the studies in AI; it is known that AI can improve itself, has the ability to learn, has superior analysis ability, and has the ability to create special experiences for users. It can be said that AI contributes to business management education when it is thought that it is nourished by the knowledge, learning, and teaching.

Use of Artificial Intelligence in Business Management Education

Artificial intelligence is an important technology that supports daily social life and economic activities (Huimin, Yujie, Min, Hyoungseop, & Seiichi, 2017). In order for AI to be used in management education, it may be necessary to look at business management education in a macro, micro, and meso way. This three-point perspective can be an integral part of business management training, as it is both inclusive and partitioning.

We can classify macro, meso, and micro perspectives when we integrate management training with induction and induction methods into AI (virtual reality, algorithm, artificial neural networks, etc.). The main purpose of this section is to classify the benefits of AI in business management in three different sections.

To integrate artificial intelligence into management education in terms of micro: Individual-based enterprise refers to the use of AI in management education. Artificial intelligence, which is created based on human intelligence/mind, is divided into subgroups. However, AI is a model of technology in which certain features developed by humans are taught and then presented to people by developing and using these technologies. Nowadays, as a result of the studies on AI; it is observed that AI can develop itself as a human brain, has the ability to learn, has superior analysis ability, and has the ability to create special experiences for users. The most important factor here is the fact that AI is fed by knowledge. The use of AI, which has the skills of learning and teaching, in business education can provide a large benefit like a human brain. It can offer significant advantages in education for students and trainers, especially from a micro perspective. (Pehlivan, 2018). These are as follows:

- Artificial intelligence can provide the opportunity to automate basic educational activities.
- Artificial intelligence can provide the training for the students' needs.
- Artificial intelligence can better understand the shortcomings of students and provide direct assistance for development.
- Provide training staff in the field of business education with AI and provide educational support to students.

- Artificial intelligence-based programs can provide useful feedback to students.
- Artificial intelligence can change the role of educators by changing the interaction of knowledge with AI.
- Artificial intelligence can lead to a more active use of trial and error learning.

The educational system, in which individuals are assumed to be at the same level, slowly begins to disappear. The availability of educational content that can be adjusted according to the learning speed of the individual is increasingly in need. It can be thought that the content of the textbooks used at this point in business education is based on the learning speed of each individual. It should be kept in mind that business education is an area that develops every day and continuously adds innovations. The yields of the individual are:

- Missing points can be detected instantly.
- The entire development process of the individual in education can be stored.
- Loss of time can be prevented.
- It is not only the wrong points of the individual but also the reasons why they made the mistakes (Sasmaz, 2018).

The use of AI in management education in terms of meso, refers to the use of enterprise business in all systems of the organization as a whole for the organization and the enterprises business. The reason why AI has more effect than in the past is today's powerful computer technology. This technology is widely used in almost all organizations today. With the help of well-designed computer arguments, organizations are able to keep a lot of data and are able to process these data held by many programs. Educational institutions such as colleges or universities need to think together with AI developers and educational institutions should understand what this technology is. Business management education schools use these data to improve their educational areas and can provide the development of education in schools with AI. Artificial intelligence developers used in education need to better understand what is learning and teaching. Otherwise, AI cannot be expected to be useful in education.

From the macro point of view, the integration of AI into management education can increase the level of education of the society in the field of education. The use of the same idea in business management education may result in a two-way fault: (a) the benefit of the community which is formed by the individuals and organizations raised in this field by its use in business management education, and (b) the use of AI in the management of enterprises and the benefit in their fields of activity. These two benefits will benefit both the community and the country. Besides, this brings to mind the question: “Can the rapid development of the automation system have the competence to manage the states of AI in the future?” For example, today, with the introduction of 4.0 automation systems in the field of industry, the factories have been managed by AI. Artificial intelligence can be managed as a leader who manages their own countries, makes strategic decisions, is knowledgeable, intelligent, and can meet the expectations of people. An AI that can lead the country can be very far from our minds today, but rapidly developing technology can make this kind of management possible at a later time.

The Use of Artificial Intelligence as a Data Collection Kit in Business Management Education

This change needs to be managed in order to keep up with the rapidly changing change, thinking that it is not possible to stop the change. For this purpose, it is necessary to use both the intelligence and the other technological devices (like virtual reality), which are the newest technologies of management, in the field of business management education. Virtual reality technology, as a data collection technique in research methods, can be used in the stage of data collection closer to reality and faster. It can also be done by analyzing these data collected with virtual reality. The results can be used as a decision-making method in line with possible future estimates. In other words, the scientific data collected with a virtual reality can be obtained in the form of the closest to the reality in terms of contributing to the management education and form the tool in making the decision about the future. Artificial intelligence can play a role in the creation of new alternatives by reshaping the data collected with virtual reality. Artificial intelligence has the ability to perform processes similar to the processes of learning and decision making, which can follow suit the processes in human biology, attach importance to human cognitive processes (Mata et al., 2018). Therefore, the use of virtual reality and AI in the collection and analysis of data in research methods in the field of business management can provide more objective and better analysis in this field.

Why Should We Benefit From Artificial Intelligence in Business Education?

With the use of AI in education, each student can be analyzed separately, the deficiencies can be determined and contributions can be made to complete the deficiencies. It is necessary to adopt a personal approach in management schools by integrating the AI in the previous section with micro integration into business management education. For example; in a high school in China, it has been articulated with face recognition technology to analyze how students follow the course. This system analyzes the face of students and how they are interested in the course.

In addition, the use of AI in the management schools and the recently encountered information, pollution can be ended. Artificial intelligence can prevent these problems because it is aimed to convey the information clearly and accurately in business education. Since it is known that the most basic purpose of business management is the easiest and most successful implementation in practice, it should be accurate and comprehensible in the information and education transferred. The most important factor here is the role of educators (teachers in business management school). Therefore, it is planned to conduct field research in order to measure the initial reactions and to determine the perspectives of AI in business management education. It is thought that educators in this area will have their ideas and suggestions about using AI in management schools. The main objective here is the rapid development of AI in the field of education. For this purpose, the perspectives of the teaching staff in the schools of management are important. We may be standing on the threshold of business education, where information is free from pollution, more accurate, and easier access and feedback can be quickly received. In many recent studies, the use of AI is aimed to provide more accurate and easy information in the education of individuals. This brings to mind the question: "Can the rapid progress of these developments lead to the loss of the importance of colleges or universities in the future?"

LIMITATIONS OF ARTIFICIAL INTELLIGENCE IN THE FIELD

Can we entrust business management training to the training of AI? Or should we be afraid of AI as Stephen Hawking and Elon Musk thought?

Artificial intelligence is biologically designed from the human nervous system. It is a complete set of software and hardware with speech, voice recognition, movement, information, and knowledge. This system, which uses superior technology, has accounting and reasoning ability. However, it can be said that there is a deficiency in some parts of this system compared to the human nervous system (Huimin et al., 2017).

When we look at the working area of the human nervous system, the system consists of 7 parts.

As shown in Figure 2.1, thinking, seeing, listening, inventing, moving, looking, and talking. Artificial intelligence provides competence in 4 parts of the human nervous system. When these limitations are analyzed in terms

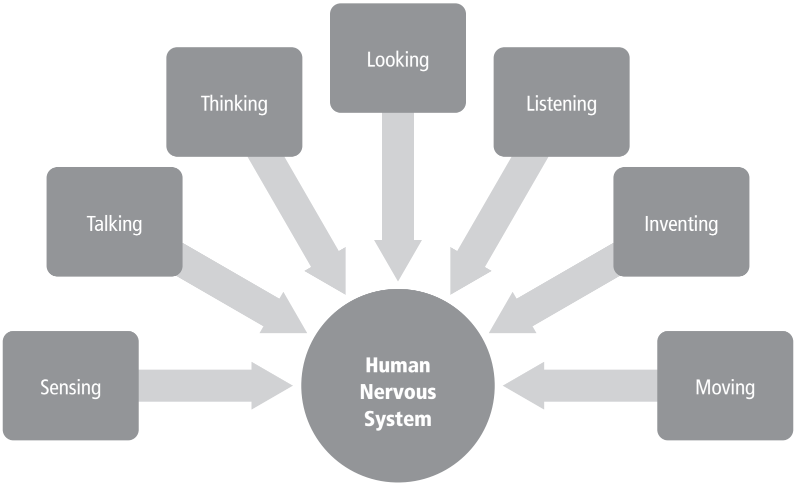

Figure 2.1 Sections of human nervous system.

of business management education, it is thought that AI can be used in areas such as image processing, speech, perception, and natural language processing.

Artificial intelligence is not yet able to provide competence in 3 areas of the human nervous system. These areas, as shown in Figure 2.2, are not yet sufficiently developed: sensing, thinking, and inventing.

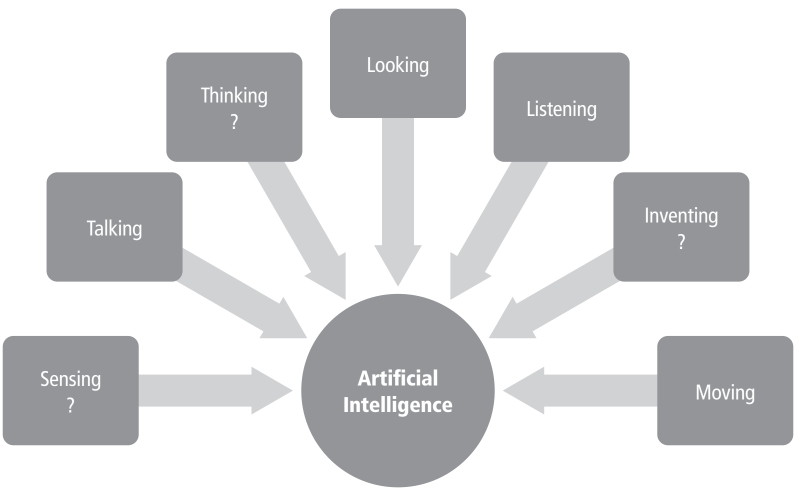

Figure 2.2 Areas not yet sufficiently developed in the areas of sensing, thinking, and inventing.

Four competencies (listening, moving, looking, and talking) in which AI is sufficient in the field of management education will be useful as in other fields of education. However, it can be thought that AI may be incomplete in thinking, seeing, and inventing for the concept of management. Because thinking and creativity are two important factors for management education, these missing factors causes concern in regard to management education. Since the emotions are transformed into thoughts in the human brain, AI will not be sufficient for management education. However, research and studies are continuing rapidly in these areas where AI is incomplete.

CONCLUSION AND DISCUSSION

Artificial intelligence, which is the most talked about, the most discussed and researched system of superior technology, needs to be integrated as soon as possible for the use of business management education and research to be behind the era. It is necessary to educate thousands of young people in the methods and techniques of scientific futures by requiring strong, new utopian and anti-utopian concepts instead of management education and research following old paradigms. We need to adapt to the changing speed and try to capture the most accurate images of future opportunities. It can be seen that the management education and research which can be the most suitable to the speed of today can be by using AI. Information can be collected by connecting a device to detect the emotions of people in the virtual reality data collection system.

We have been slow to integrate to integrate AI, which has been spoken of and discussed since the 1950s, in business management education, which was inspired by the behavior of all human beings in nature and their behavior. Almost for the last 5 years, AI has found an application area in all areas.

However, it is thought provoking that it has not been seen in business education so far. The reasons for this may be that the constraints in the field of business education, other than the points where AI is incomplete, and the fact that individuals working as trainers in this field do not consider the concept of AI. Individuals working in this field should work to integrate AI into the field by going beyond the old-fashioned methods.

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CHAPTER 3

ARTIFICIAL INTELLIGENCE

From Business Schools to Management Schools

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PURPOSE OF THE CHAPTER

In 1951, Feynman taught a course in Brazil on electricity and magnetism to very bright students about to become teachers. He recounts an incident where he asked them about the meaning of a formula they could describe with precision and discovered they didn't have the slightest idea of its use.

> [...] I asked them how one could tell the absolute direction of polarization, for a *single* piece of polaroid.

Management and Business Education in the Time of Artificial Intelligence, pages 27–53

> They hadn't any idea.
>
> I knew this took a certain amount of ingenuity, so I gave them a hint: "Look at the light reflected from the bay outside."
>
> Nobody said anything.
>
> Then I said, "Have you ever heard of Brewster's angle?"
>
> "Yes, sir! Brewster's angle is the angle at which light reflected from a medium with an index of refraction that is completely polarized."
>
> "And which way is the light polarized when it's reflected?"
>
> "The light is polarized perpendicular to the plane of reflection, sir." Even now, I have to think about it; they knew it cold! They even knew the tangent of the angle equals the index!
>
> I said, "Well?" Still nothing.
>
> They had just told me that light reflected from a medium with an index, such as the bay outside, was polarized; they had even told me which way it was polarized.
>
> I said, "Look at the bay outside, through the polaroid. Now turn the polaroid."
>
> "Ooh, it's polarized!" they said.
>
> After a lot of investigation, I finally figured out that the students had memorized everything, but they didn't know what anything meant. When they heard "light that is reflected from a medium with an index," they didn't know that it meant a material such as water. They didn't know that the "direction of the light" is the direction in which you see something when you're looking at it, and so on. Everything was entirely memorized, yet nothing had been translated into meaningful words. So, if I asked, "What is Brewster's angle?" I'm going into the computer with the right keywords. But if I say, "Look at the water," nothing happens—they don't have anything under "Look at the water!" (Feynman, 1985, p. 221)

That was written in 1951. If we do the same research today (November 10, 2018) in Google, "Brewster's angle" gives 170,000 results, "Look at the water" three billon and "Look at the water, Feynman" 986,000.

Does that mean that Feynman's purpose of wanting his students to ground the abstract in reality is irrelevant today, when information is a flood if not a Tsunami?

What Feynman was trying to accomplish, during his conversation with the students, was to pivot between the abstract and the concrete; a property of "insight," belonging to the process of thinking and manifesting intelligent behavior. A property consisting of operations that will be described further on in order to provide the reader with grounds to develop a stance on AI's possibilities and restrictions.

In this chapter, AI is not envisioned in science fiction terms. All sorts of doomsday speculations mar the study of its possibilities and limitations. Rather, AI can be envisioned as a complement to man's intelligence and other human dimensions that will bring about unforeseen consequences; some positively enhancing his intelligence and thus his humanity, and others negatively eroding people's autonomy as will be discussed further on.

Some challenges can now be foreseen with respect to the meaning of work and its forms, the pressing concern for the university's role and particularly business and management education. It is worthwhile delving into them. But keeping in mind that technology and innovations, just as they are ethically neutral, can be employed for the common good or otherwise—it's man's knowledge and will that put them to good or bad use.[1]

Having such ideas as a backdrop, the purpose of this chapter is to underscore human dimensions and operations of the mind and the will;[2] some performable by AI artifacts in their present and near future development and some not foreseeable yet. Nevertheless, we will attempt to explain those operations that in our interpretation are existent in today's AI artifacts and the needed requirements for future university graduates to interact creatively with them.

Learning methods and pedagogical strategies need to be reconsidered. The university's traditional role, that of transmitting information or being the sole generator of knowledge is not enough anymore. Certifying course work, offering skills and competencies, contributing to building networks—to mention just a few of its present functions—is not sufficient in a world where needed skills and competencies are changing at a faster pace than they're being taught and acquired. Traditional intellectual skills like analyzing, synthetizing, conceptualizing on their own will not be satisfactory. Critical thinking (formulating the right questions) needs to come to the fore. Meditative thinking (more below) will need to offset the pervasiveness of calculative thinking. Hard skills, usually reduced only to intellectual competencies, need to be refined by soft skills—common sense, ability to deal with people, and open mindedness. It is anticipated, then, that a much higher and encompassing purpose will ensue the university's current role.

A general climate of uncertainty invades all dimensions of life despite a culture that laid its faith in science's unbounded progress and technology's ending all of humanity's ailments. On the one hand, science and technology pretend to build a future amiable to man, on the other, some of its contrivances seem to produce unforeseen consequences that question man's sustainability on earth. Furthermore, leadership globally lives a moral crisis that questions the role of universities—all leaders with a handful of exceptions are university graduates. And so, it is pertinent to ask

> whether higher education and especially business schools have forgotten their prime objective: not only promoting the discovery and exchange of knowledge and ideas but also educating wise people who will be equipped with knowledge and integrity. Questions also rise as to whether the academic environment truly shapes the moral attitudes of young people and creates the appropriate examples for them. (Stachowicz-Stanusch, 2012, p. 22)

The psychological demands of such uncertainty, prompts, it is our contention, cultivating character strengths in all members of universities in ways not yet visualized by conventional higher education. All this will be required if we pretend graduates have control over AI.

WHAT ARTIFICIAL INTELLIGENCE CAN OFFER FOR THE TIME BEING

It is impossible to approach the consequences of AI on higher education without some model of operations of the mind that will aid the argument presented here. As a knowledgeable author of AI suggests, Hector Levesque (2017), formulating the question about if AI performs operations of the mind and to what extent, will never be settled. It will not be settled because terms like "thinking," "mind," "intelligence," "consciousness," and so forth, are entities present in all human life, but difficult to build consensus around their meaning and so become for practical purposes undefinable. Not necessarily indescribable.

Science advances on knowledge of the brain at gigantic leaps; it is now known not only where the centers for vision, hearing, memory are located, but where pain and the patient's behavior is located (Twilley, 2018), too, where ethical decisions are taken. We can describe the neural connections and reactions to external and internal signals. But one thing is the brain and another, the mind.

Levesque (2017) refers to the "Big Puzzle issue" in order to signal the fact that today from a handful of scientific disciplines contributions are made to aspects of those entities. Nevertheless, he advises that

> we need to train ourselves to be skeptical of any research group that insists that one part or the puzzle is the true core, the key to the whole thing [...] let us call the issue of confusing a handful of pieces for the entire puzzle the *Big Puzzle* issue [...] how are we then to talk about thinking at all without falling to pompous oversimplifications? (p. 17)

In the 1950s, the term *artificial intelligence* was coined by a group of researchers that were advancing the subject. They referred to the "good old fashion AI" (GOFAI) whose purpose was somewhat different from what is developing today. Their hypothesis underlying AI was that human ordinary thinking "is also a computational process, and one that can be studied without too much regard for *who* or *what* is doing the thinking" (Levesque, 2017, p. ix).

Today what is leading the field is adaptive machine learning (AML) relying on large amounts of data, very fast computers and sophisticated techniques that process the data. Originally, the GOFAIs asked themselves two questions. "How do we make programs that learn from their experience as effectively as humans?" Secondly, "How do we make [the programs] capable of being told [by] a program to learn something?" These concerns of the GOFAIs are still being pursued.

This line of research about AI whose assumption about aspects of thinking being assimilated to computational processes allows then for findings about the mind that give credit to Larry Tesler's—the computer scientist who invented copy–paste—suggestion that human intelligence "is whatever machines haven't done yet" (as cited in Friend, 2018, para. 11). In other words, knowledge about: thinking, mind, intelligence, consciousness—human realities that make AI possible—will benefit from the capabilities and barriers demonstrated by the advance and ever new discoveries of AI.

If we make a negative analogy in order to illustrate said process of discovery with pain, sickness, and health, many ailments and diseases have been cured, but new ones come into the picture: to mention a couple, AIDS and cancer, unheard of some decades ago. Research, new drugs, and treatments have improved the health of many patients suffering today from them. There is no doubt that medical practitioners, drugs, and hospitals will always be needed in order to keep known diseases and ailments under control while discovering, diagnosing, and treating the new ones.

The conditions and state of being healthy draw on the increased knowledge we have about our metabolism, genetics, and our lifestyle today which differs from what we thought was being healthy 50 years ago. Similarly then to what medicine and natural sciences have accomplished during the course of their history up to the present day, AI artifacts may follow. What AI artifacts haven´t accomplished presently, but will possibly do so in the future, will manifest ever new dimensions of the human mind and unknown aspects of thinking, intelligence, and consciousness that we now take for granted.

Higher education then will have to offer its future graduates knowledge about the presuppositions that underlie natural sciences and its consequent technology, including social sciences. Furthermore, it will have to show its students that science doesn't encompass all human knowledge; art, literature, philosophy, theology, and religion all contribute to the needed historical mindedness of future graduates if they want to cope with the complexity that the digital age will demand of them.

Modernity promised to have science and technology, freed from thought traditions of the past, bring about autonomous individuals capable of driving humanity towards and incessant material, social and moral well-being never seen in the past. This promise hasn't been fulfilled. Presently, the biosphere's sustainability is besieged. The rampant social and economic inequity related to the digital divide, now not only among countries but within countries, questions the true ability of science only to bring about the flourishing of humanity. This does not mean that AI does not have a very important role to play—as long as its developers don't fall prey to the Big Puzzle issue claiming that AI will solve all of mankind's predicaments and that it can perform all the thinking operations of the mind.

AI AND INFORMATION

Communication among humans has increasingly been aided by innovations. All of them cumulative in the sense that the preceding is incorporated into the latest. Language, drum or fire signaling, writing, Gutenberg's printing, telegraph, phone, radio, TV, internet, cellphones, have all been essential for societies' development. Despite many debating what was the most important insight of the past century, we will settle on the fact of naming "information" and being able to measure it: the bit, despite it not being a physical thing. Information since then plays a role equivalent to those played by notions like gravity in Galileo's time; force, mass, motion whose workable meaning was possible by Newton's quantifying them. In the 19th century, energy was given a precise and measurable meaning.

The Bell Laboratories engineers, in the 1940s, were the first ones to speak of "information" and Claude Shannon, working there in 1948 published the seminal paper that would give "information" its citizenship. Created in the context of said corporation's research initiatives, initially it was thought as an engineering technical term, although Shannon's initial idea was working on the analysis of some of the fundamental properties of general systems for the transmission of "intelligence" (Gleick, 2011, Preface). Since then information is not just a neologism. It is a way of describing reality. And there is no doubt that today it indeed transmits an important portion of human beings' intelligence.

The shift from scribes to print, allowed by Gutenberg's press, started a communication revolution that is still underway. Having books available (not manuscripts that only privileged groups had, i.e., kings, lords, monks) starting with the Bible meant a democratization of knowledge. Science, in the 17th century took leaps when findings of researchers could be checked by others using the same logarithmic tables. Forms of knowledge achieved stability because several copies of the same content existed. Even written history as we know it today was possible: "The sense of *when* we are—the ability to see the past spread out before one; the internalization of mental charts; the appreciation of anachronism—came with the shift to print" (Gleick, 2011, p. 399).

In the last half of the 20th century an unusual situation came about. When more than half of the world's population might be uninformed of the happenings of their immediate surroundings, other populations live an information indigestion. New words were accepted by the OED in 2009: "information overload," "information glut," "information fatigue" meaning an

> apathy, indifference, or mental exhaustion arising from exposure to too much information esp. (in later use) stress induced by the attempt to assimilate excessive amounts of information from the media, the internet, or at work. Sometimes information anxiety can coexist with boredom [. . .] the sensation of drowning and of a loss of autonomy, of personal responsibility for being *informed.* (Gleick, 2011, p. 403)

A case in point are natural sciences like botany whose development underwent a significant progress starting in the 16th century. It needed to answer the information overload of its discipline. The conquest of new territories led many explorers to collect new flora in varieties and quantities yet unknown; this required new methods of classification in order to deal with these unknown varieties.

The present situation might well be described by the fact that

> new information technologies alter the existing landscape, they bring disruption: new channels and new dams rerouting the flow of irrigation and transport. The balance between creators and consumers is upset: writers and readers, speakers and listeners. Market forces are confused; information can seem too cheap and too expensive at the same time. The older ways of organizing knowledge no longer work. Who will search; who will filter? The disruption breeds hope mixed with fear. In the first days of radio Bertolt Brecht, hopeful, fearful, and quite obsessed, expressed his feeling aphoristically: "A man who has something to say and finds no listeners is bad off. Even worse are the listeners who can't find anyone with something to say to them." The calculus always changes. Ask bloggers and tweeters: Which is worse to many mouths or to many ears? (Gleick, 2011, p. 412)

In all probability then the situation of increasing information will be dealt with, if not with new sciences, at least with new lifestyles, ways of communication, and new forms of organizing society, the economy, politics, and even the state.

So when does information and AI come into our picture? As mentioned above, Shannon's original quest was to transmit "intelligence." It has happened depending on what "intelligence" is considered to be. The explosive mixture of a non-physical entity that has always been existent but not recognized, measured, or named until recently: "information," plus computers' apparently limitless calculating power together with the Internet's sweeping communication potential, foster giants like Amazon, Apple, Facebook, and Google that we will briefly overview in order to have an idea of what can AI originate.

AMAZON

Amazon is a retailer that has truly revolutionized retailing. Innovations like the department store that allowed customers to shop and buy a variety of items, taken care of by trained floor associates that worked for commissions left the corner store an historic icon. Then came the mall, that by 1987 accounted for half the retail sales in the United States. Bar coding and retailers offering discounts for bulk purchases (a practice lawmakers had forbidden up to the 1960s), made Sam Walton for a time the world's wealthiest man with Walmart destroying jobs but allowing customers the best deals possible of any retailer. Walmart leveled the consumption habits of the general population. Then specialty retail served a fraction of the population that wanted special attention and were willing to pay a premium for it. Finally, came Amazon. In the words of a marketing professor at NYU:

> Jeff Bezos happened more to retail than retail happened to Jeff Bezos. In each of the preceding eras of retail, there were brilliant people who tapped into the shift in demographics or taste that created billions of dollars in value. But Bezos saw a technological shift, then used it to reconstruct root and branch of the entire world of retailing. E-commerce would be a shadow of itself, had Bezos not brought his vision and focus to the medium. (Galloway, 2017, p. 23)

And what was Bezos' vision and focus? To have made of retailing a virtual entity bringing together millions of customers and retailers without having to occupy physical space in order to provide goods and services in stores nor hire thousands of employees. And all this due to the Internet, and AI since every website page is a store and every customer a sales person. This is so presently, customers can see several alternatives on the screen before selecting and clicking. But soon with Alexa—internet smart—, where voice will guide the buying on Amazon, it can direct customers only to its private label and so erode the margin from brands. For Galloway, "the death of brands, has a name . . . Alexa" (Galloway, 2017, p. 52).

Amazon has given the machine learning mode of AI a full development. It has allowed it to intuit most of a customer's consuming behavior anticipating future needs and so offering, via Alexa, best buys. Such Tsunami of the retail market in the United States has positioned Amazon as the fastest growing company above Apple, Google, and Facebook with whom, although originally belonging to different sectors are now waging capitalization wars amongst themselves.

APPLE

No other company in the history of economics has reached a trillion dollars in market value. Apple did so this year (2018). While having in 2016 only 14.5% of the global market share of smart phones, Apple captured 79% of its profits. Why was this so? Because it was a luxury device, the icon of innovation (Galloway, 2017, p. 70). Surrounding Apple devices, a new culture has set in. Macolytes—who profess a cult to Steve Jobs and are fanatically devoted users of Apple products—are a social class of their own, that stand up against any threat of the company's autonomy or government's infringement. When required by the FBI to unlock the San Bernardino shooter's iPhone by a judge's search warrant, Apple rejected it without any further government action.

In Galloway's interpretation, a market consulting expert for luxury brands, Apple's bet has been to target a luxury thirsty population with devices that allows them to stand out from the crowd. These devices establish a digital divide. A heat map for mobile operating systems and geography of wealth shows that Apple IOS predominate in Manhattan while Androids belong to Bronx or New Jersey's population where average household income plummets. Los Angeles shows a similar trend. "The iPhone is the clearest signal that you are closer to perfection and have more opportunities to mate" (Galloway, 2017, p. 76).

Apple betted on making their products: Mac computers, iPad, iPhones customer friendly, any age group and profession, gender, as long as they belong to the upper echelons of society. This holds true for the North and the South. Somehow then AI not only aids hardware development but creates trends and digital divides.

FACEBOOK

The following comparison helps understanding this company's success population number wise. It took about 50 centuries for the West to consider the now 1.4 billon number of Chinese people existent. It took 20 centuries to speak of today's 1.3 billon Catholics. Only in one-year Disney World was visited by 17 million. Nevertheless, just in a decade Facebook, Inc. established a meaningful relationship with 2 billion people. A relationship that with its three apps: Instagram, WhatsApp, and Facebook entail an average of 50 minutes of its user's time.

While Google took away the display advertising revenues from traditional media, Facebook beats it by being able to target individuals who put years' worth of personal content on their pages. Galloway expresses this fact with irony:

> Facebook, by analyzing every bit of data about us, might come closer to understanding us than our friends. Facebook registers a detailed—and highly accurate—portrait from our clicks, words, movements, and friend networks. By comparison, our actual posts, the ones designed for our friends, are mostly self-promotion. Your self is an airbrushed image of you and your life, with soft lighting and a layer of Vaseline smeared across the lens [...] However, the camera operator, Facebook, isn't fooled. It sees the truth—as do its advertisers. This is what makes the company so powerful. The side that faces us, Facebook's users is the bait to gait us to surrender our real selves. (Galloway, 2017, p. 99–100)

What the movie HER shows with the cell phone eavesdropping on all of the actor's surroundings, Facebook has today with an AI-augmented listening software that draws data on what you are doing, with whom you are talking and the topic of discussion. So, "If you carry a cell phone and are on a social network, you've decided to have your privacy violated, because it's worth it" (Galloway, 2017, p. 104).

Presently, Facebook is the largest driver towards news. Despite its refusal to being considered media, both giants (with Google) are moving with large leaps towards being so.

In other words, ever more sophisticated AI allows targeting behavior of individuals, not only needs for consuming, but personality aspects that allows these corporations to anticipate their user's behavior.

GOOGLE

Of the four giants, it was Google that was the founding company to make use of AI as its most valuable asset. To handle daily 3.5 billion inquiries about just anything and receive reliable information about what was asked has clad Google with a god-like aura. With religious belief receding in the North (and there particularly), although it is a phenomenon present today everywhere, people don't look up for answers as they did in the past but look them down on their screen. Searching Google has become a ritual and for some, probably not realizing it, a substitution to the oldest prayer of Christianity:

Our Google, who art in cyberspace,
Hallowed be thy domain.
Thy search to come,
Thy results be done,
On 127.0.0.1 as it is in the Googleplex.
Give us this day our daily searches,
And forgive us our spam,
As we forgive those who spam against us.
And lead us not into temptation,
But deliver us from Microsoft.
For thine is the search engine,
And the power,
And the glory,
Forever and ever.
(Lee, 2016, Sec 2.22)

As was mentioned above, technology cannot be made responsible for the menace it inflicts, it is its users who are to blame, be it covetousness, pride, or sincere solidarity and wishing to do good (Google's "Don't Be Evil" Mantra, recently watered down), it is well to ask if these giants really have control over what they do.

Having briefly delved on the market consequences, the social rearrangements, and economic and political power that AI has provided to these giants, it is worthwhile to question their sustainability. Meteoric value creation for themselves accompanied by massive unemployment to whole sectors of the economy, life styles deepening the digital divide and communication habits whose consequences are not yet foreseen.

Not much can be gained by speculating on the future of these companies, but it is worthwhile trying to understand the underpinnings of AI from a model of how is it that the mind thinks. In other words, what is intelligent behavior as is being considered in this chapter.

A MODEL FOR INTELLIGENT BEHAVIOR

It was mentioned that AI will aid a better understanding of operations of the mind as it advances in its developments and posited a handful of examples on how it can alter the economic and social order. A model of mental operations is now suggested; intended not as unquestionable definitions of thinking, mind, intelligence, and consciousness but as descriptions that will allow us to develop the chapter's argument.

It is helpful to draw on the mid-20th century Canadian thinker Bernard Lonergan, a philosopher who investigated said operations in order to explain science's method. Said notions are presented not asking from the reader's full agreement, but just considering that if based on them the argument offered stands its ground.

INSIGHT

In a recent review of his favorite books on AI, Nick Harkaway (2018) confesses that

> the problem with AI is that while it's relatively easy to define the "A," the "I" remains elusive. We don't know what our own intelligence is, nor how we generate our familiar conscious experience, so it's tricky to know how we might create an artificial consciousness, or indeed recognize it if we did. (para. 10)

A solid basis, then, to face the problems posed by AI is to have some ideas or notions about what our own intelligence is about. A basic start is to focus on our familiar conscious experience of intelligence. An appropriate strategy for such endeavor is to reflect on concrete instances of intelligent activity and behavior. An excellent one is provided by the story of Archimedes of Syracuse dealing with King Hiero's golden crown. Imagination has portrayed the scientist suddenly jumping out of the public baths and running naked through the street of the city while crying out "Eureka," the perfect tense of the Greek verb *heuriskein* (εὑρισκειν), "to find," "to find out, discover," "to find out for oneself," "to devise, invent" ("An Intermediate Greek–English Lexicon," 1889, pp. 331–332). King Hiero had called Archimedes to find out whether a votive crown ordered to a smith of rare skill and doubtful honesty had been fashioned out of pure gold or with a mix of baser metals. The story describes Archimedes wracking his brains and forgetting to eat and sleep and dramatizes the moment he descends into the pool and realizes the waters overflowing over its edge.

Let's call Archimedes' moment of illumination the occurrence of an "insight," an act of understanding, of intelligent behavior, of intelligence in action. Lonergan has provided an accurate description of that event in his work *Insight: A Study of Human Understanding* (Lonergan, Crowe, & Doran, 2000). As "Archimedes had his insight by thinking about the crown," he writes,

> We shall have ours by thinking about Archimedes. What we have to grasp is that intelligence is a process in which insight (a) comes as a release to the tension of inquiry, (b) comes suddenly and unexpectedly, (c) is the function not of outer circumstances but of inner conditions, (d) pivots between the concrete and the abstract, and (e) passes into the habitual texture of one's mind. (Lonergan, Crowe, & Doran, 2000, BLCW 3:28)

It is useful to detail now each of these dimensions of insight. In the first place, it is a release of tension. Lonergan's best example is the above-mentioned Archimedes' *Eureka*. It was a release of the tension of a deep-seated inquiry—that of finding how much gold the king's crown truly carried—and its associated effort and concentration in finding the solution to the problem. There is within us all, the other appetites being stilled, a drive to know, understand, discover, and see why, find the cause, and explain the reasons for answering the question that moved us.

> It can absorb a man. It can keep him for hours, day after day, year after year, in the narrow prison of his study or his laboratory. It can send him on dangerous voyages of exploration. It can withdraw him from other interests, other pursuits, other pleasures, other achievements. It can fill his waking thoughts, hide him from the world of ordinary affairs, invade the very fabric of his dreams. It can demand endless sacrifices that are made without regret though there is only the hope, never a certain promise, of success. What better symbol could we find for this obscure, exigent, imperative drive, than a man, naked, running, excitidly crying, "I've got it"? (Lonergan, Crowe, & Doran, 2000, BLCW 3:28–29)

Secondly, insight comes suddenly and unexpectedly. It is reached not by learning rules, nor following precepts, nor studying any methodology. On the contrary, it is a discovery, a new beginning and origin of new rules that can supplement or even supplant the old. It is genius by disregarding established routines while laying new routines for the future. Being an act of genius then there doesn't exist precepts, otherwise those discoveries would be mere conclusions.

What has been said for discoveries holds for its transmission, the role of teachers, whose only possibility is to present elements in such an order and distribution of emphasis for the pupil's understanding, being conscious that

> some get the point before the teacher can finish his exposition. Others just manage to keep pace with him. Others see the light only when they go over the matter by themselves. Some, finally, never catch on at all; for a while they follow the classes, but sooner or later they drop by the way. (Lonergan, Crowe, & Doran, 2000, BLCW 3:29)

A third point Lonergan makes is that insight is a function not of outer circumstances, but of inner conditions. Insight differs from sensation. Those in Archimedes' time that bathed with him felt the water cold or hot as he did, were looking around and were not concerned about the King's crown. But Archimedes, instead, was deeply concentrated in the problem and so his internal conditions were definite.

> Thus, insight depends upon native endowment, and so with fair accuracy one can say that insight is the act that occurs frequently in the intelligent and rarely in the stupid. Again, insight depends on a habitual orientation, upon a perpetual alertness ever asking the little question, Why? Finally, insight depends on the accurate presentation of definite problems, had Hiero not put his problem to Archimedes, had Archimedes not thought earnestly, perhaps desperately, upon it, the baths of Syracuse would have been no more famous than any others. (Lonergan, Crowe, & Doran, 2000, BLCW 3:29–30)

Fourthly, insight pivots between the concrete and the abstract. Archimedes' problem was concrete and his solution too, to provide the King with a concrete answer. But between problem and answer there was a principle discovered by Archimedes about volume displaced and specific gravity.

> Because insights arise with reference to the concrete, geometers use diagrams, mathematicians need pen and paper, teachers need blackboards [...] But because the significance and relevance of insight goes beyond any concrete problem or applications men formulate abstract sciences with their numbers and symbols, their technical terms and formulae, their definitions, postulates, and deductions. Thus, by its very nature insight is the mediator, the hinge, the pivot. It is insight into the concrete world of sense and imagination. Yet what is known by insight, what insight adds to the sensible and imagined presentations, finds its adequate expression only in the abstract and recondite formulations of the sciences. (Lonergan, Crowe, & Doran, 2000, BLCW 3:30)

And finally, insight passes into the habitual texture of one's mind. Arriving to the first moment of inspiration usually takes a large effort. But once the divide of insight has been crossed, the solution to what was thought to be an insoluble problem allows for subsequent repetitions almost at will. This is the possibility of learning. It is something reminiscent of Einstein's lemma about discovery requiring: "a drop of inspiration and ninety-nine of effort," that summarizes well Lonergan's last point.

> For we can learn inasmuch as we can add insight to insight, inasmuch as the new does not extrude the old but complements and combines with it. Inversely, inasmuch as the subject to be learnt involves the acquisition of a whole series of insights, the process of learning is marked by an initial period of darkness in which one gropes about insecurely, in which one cannot see where one is going, in which one cannot grasp what all the fuss is about; and only gradually, as one begins to catch on, does the initial darkness yield to a subsequent period of increasing light, confidence, interest, absorption. Then the infinitesimal calculus or theoretical physics or the issues of philosophy cease to be the mysterious and foggy realms they had seemed. Imperceptibly we shift from the helpless infancy of the beginner to the modest self-confidence of the advance student. Eventually we become capable of taking over the teacher's role and complaining of the remarkable obtuseness of pupils

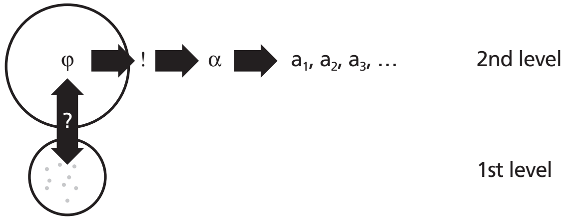

Figure 3.1 Operations of intelligent thinking.

> that fail to see what, of course, is perfectly simple and obvious to those that understand. (Lonergan, Crowe, & Doran, 1992, BLCW 3: pp. 30–31)

Lonergan's description of Archimedes' experience can be diagrammed as a sequence of four interrelated activities (see Figure 3.1) of mind: inquiry, imagining, insight, acting of insight. Activities are represented by symbols like "?" for inquiring, questioning, asking and "!" for understanding, finding out, discovering, inventing, and, by Greek letters like "φ" (phi) and "α" (alpha); blue lines highlight relations between activities: the blue circle, the tension between questioning and imagining; pointed blue arrows, the release from tension into insight, the expression of insight in an inner word, the manifestation of the inner word in multiple and diverse outward expressions (a_1, a_2, a_3, . . .) of the inner word of understanding. Insight is a release from the tension of inquiry, and acting (in any form, speech, writing, doing) is an expression of an act or set of acts of understanding. The initial situation can be pictured as happening at two levels of thought: as a cloud of dancing dots at Level 1 and the result of the occurrence of an act of understanding, as an ordered line of dots (. . .) at Level 2. Briefly, the story of Archimedes provides a powerful illustration of how a brilliant flash (!) of understanding can be formulated (α) as "the physical law of buoyancy" while providing at the same time "a principle" to work out millions of useful applications (a_1, a_2, a_3, . . .) as it is the construction of ships from small boats to ocean liners.

METHOD

The attention to the way intelligent thinking works, provides us with a method to analyze the works (*opera*, that is, a_1, a_2, a_3, . . .) of intelligence.

This will contrast with notions about thinking like those offered by authors in the GOFAI[3] tradition for whom

> intelligent behavior are intelligent choices about what to do . . . they are intelligent through the use of background information called knowledge. And

> the application of the latter the behavior at hand is what we call thinking. The problem that needs to be sorted out is how, in concrete terms, this all works, how background knowledge can make a difference in an agent deciding what to do. The solution we consider is a *computational* one. In the same way that digital computers perform calculations on symbolic representations of numbers, we suggest that human brains perform calculations on symbolic representations of knowledge, and then use the result of those calculations to decide how to act. (Levesque, 2017, p. 18)

Such reduction leaves very important dimensions of thinking aside, like distinguishing insight and understanding, whose consequences we will analyze later. It will serve the argument by commenting on a recent happening when one of the four giants, Facebook, whose reduction of human communication to "likes" and "non-likes" claims their ideal-pursuing mission "to make the world more open and connected" and not admitting that their main mission is profit driven.

A case in point is the recent controversy about the nature of Facebook's role in fostering trustful social relations. Recent events have inspired Bret Stephens (2018), an opinion columnist of *The New York Times*, to write an insightful essay on "How Plato Foresaw Facebook's Folly." Stephens evokes a dialogue told by Socrates, between Theuth, an "inventor of many arts, such as arithmetic and calculation and geometry and astronomy and draughts and dice, but his great discovery was the use of letters," and "the god Thamus was the king of the whole country of Egypt" (Socrates, *Phaedrus,* p. 275a). When Theuth displayed the importance of the invention of writing the god points that "the parent or inventor of an art is not always the best judge of the utility or inutility of his own inventions to the users of them" (p. 275a) Theuth had strongly argued that the use of letters "will make the Egyptians wiser and give them better memories; it is a specific both for the memory and for the wit" (p. 275a). To which Thamus responds that inventors regard their works as parents with their children. And wisely adds:

> You who are the father of letters, from a paternal love of your own children have been led to attribute to them a quality which they cannot have; for this discovery of yours will create forgetfulness in the learners' souls, because they will not use their memories; they will trust to the external written characters and not remember of themselves. The specific which you have discovered is an aid not to memory, but to reminiscence, and you give your disciples not truth, but only the semblance of truth; they will be hearers of many things and will have learned nothing; they will appear to be omniscient and will generally know nothing; they will be tiresome company, having the show of wisdom without the reality. (Socrates, *Phaedrus,* p. 275a)

But sole memory is neither enough today as Feynman's anecdote at the beginning of our chapter demonstrated. Which should put us on the alert on ideal-pursuing movements especially coming from the AI giants' publicity: Google's "Don't Be Evil" or Elon Musk's Telsa's role "To accelerate the world's transition to sustainable energy" and Facebook's "Opening the world"—yes, but not to truthful and trustful relations.

Only science has been the best-known truth and trust enabler, whose method has been that of making known findings that others can replicate in order to confirm or refute. We will examine now the operations of the mind that makes this possible. We delve on it since AI has been possible mainly due to the scientific method.

It is important to rely on Lonergan's definition of method as a "a normative pattern of recurrent and related operations yielding cumulative and progressive results" (Lonergan, 1990, p. 4). These operations need to be distinct but related, the set of relations form a pattern and the pattern is the right way of performing the tasks. Too, the operations follow the pattern that may be repeated indefinitely and render fruits that are not repetitious but cumulative and progressive. Such scientific method inspires

> inquiry and inquiries recur. It insists on accurate observation and description. Both observations and descriptions recur. Above all, it praises discovery, and discoveries recur. It demands the formulation of discoveries in hypotheses, and hypotheses recur. It requires the deduction of the implication or hypotheses, and deductions recur. It keeps urging that experiments be devised and performed to check the implications of hypotheses against observable fact, and such processes of experimentation recur [. . .] So the many operations are related; the relations form a pattern; and the pattern defines the right way of going about a scientific investigation. (Lonergan, 1990, p. 5)

Researchers in the natural sciences follow these operations; the fact of being replicable allow others in the field to reaffirm or refute. Knowledge is accumulated because of new insights or because previous ones still stand their ground. And such is the idea of progress in these sciences.

It helps now to turn to higher level operations in order to place AI where an analogy can be established with the mind's operations.

LOGICAL AND NON-LOGICAL OPERATIONS

When in Figure 3.1 we referred to "a cloud of dancing dots" and placed said cloud at 1st level operations, we were referring to seeing, hearing, touching, smelling, and tasting. We call this 1st level of operations, generally referred to as, "experience."[4] In the 2nd level we include "imagining," to which inquiry, observation, discovery, and understanding contribute. The 3rd level, that of "verifying," is where experiments are devised and performed, and so there is a need to synthesize, marshal, and weigh evidence and judge; judgments that can be of fact, probability, possibility, or value. These operations are all sketched between Figures 3.1 and 3.2. The final level (4th) is comprised by the operations of deliberating, evaluating, and deciding—to act, to execute (Figure 3.3).

A further grouping of said operations is that of logical operations, that is operations on propositions, terms, and relations. That is where the scientific method describes, formulates problems, and hypotheses and deduces implications. But said method moves outside this group to also include non-logical operations where inquiry, observation, discovery, experiment, synthesis, and verification take place.

> Modern science derives its distinctive character from this grouping together of logical and non-logical operations. The logical tend to consolidate what has been achieved. The non-logical keep all achievements open to further advancement. The conjunction of the two results in an open, ongoing progressive and cumulative process. (Lonergan, 1990, p. 6)

In a way, this consolidating and ongoing process, together with the dimension of insight described above, are the source operations that give

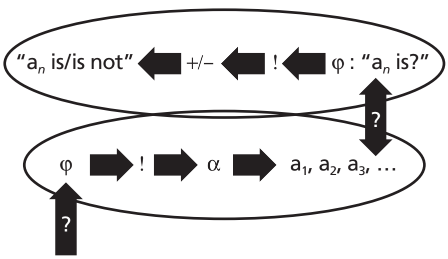

Figure 3.2 Operations of reflective thinking.

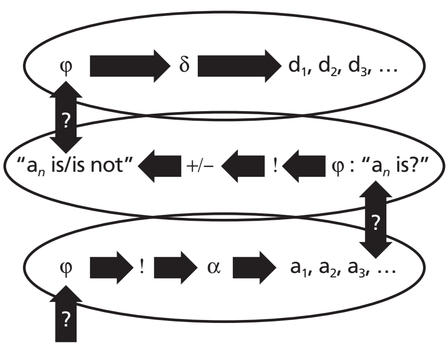

Figure 3.3 Operations of critical and evaluative thinking.

origin to AI. In other words, we conceive AI being a very elaborated product of science and its corollary: technology. But, at the same time, AI in its most sophisticated artifacts can perform logical operations, while not non-logical operations.

It is wise now to move further to qualities of these operations: intentionañity and consciousness.

INTENTIONALITY AND CONSCIOUSNESS

Let's now focus on the topic of AI. The strategy followed until now has been to understand foundation from an analysis of (I)ntelligence. On this methodological perspective, AI results to be a series of (A)rtificial realizations (a_1, a_2, a_3, . . .) from simple digital devices and tools to complex and sophisticated computers and robots. The standpoint can be reversed and proceed accordingly to a different account where (I)ntelligence is an unknown that can be explained from a consideration of (A)rtificial, that is of "thinking machines." With this standpoint "intelligence," "consciousness," and the "mind," become "not just a problem but almost a miracle," a "puzzle after puzzle," "the circle that everyone wants to square" (Pinker, 2009). This position underlines a deeper paradox implicit in the workings of intelligence. Lonergan remarks that

> when Archimedes shouted "Eureka!" he was aware of a significant addition to his knowledge, but it is not likely that we would been able to formulate explicitly what direct insight is. (Lonergan, 1992, p. 30)

In other words, Archimedes is not only intelligent, but luminously aware of the occurrence of his intelligence. He was also conscious of his deep concern for solving Kin Hiero's problem as well as, once solved the question, the formulation of his understanding in terms of laws and principles. Awareness, however, and consciousness of the operations of his mind were not explicitly formulated. Archimedes deep commitment was with the spectacular objects of his intelligent activity.

This fact drives us to a further consideration about the nature of intelligence. Besides intelligent thinking (as exemplified by the spectacular discoveries and inventions of science and technology) there is reflective thinking. It's possible to be aware of the activity of our critical mind and be coherent with its orientation, without going forward and explaining "why" our mind works critically the way it does. So, Lonergan points out that

> we perform acts of reflective understanding, we know that we have grasped the sufficiency for a judgment on which we have been deliberating, but with-

> out prolonged efforts of introspective analysis we could not say what occurs in the reflective insight. (Lonergan, 1992, p. 304)

So it happens that Harvard's Professor Pinker is indeed aware of the occurrence of intelligence in the design, fabrication, and use of AI tools and instruments. His account of intelligence, however, in terms of the workings of its children, calls for a different question: "Is that so?" The consequent affirmation "Yes, it is," following an insight that grasps "the sufficiency for a judgment," cannot be explained either in terms of the tools and machines elaborated by that intelligence.

Thinking becomes critical (see Figure 3.3) when we ask (?) whether a "product" (an) of our intelligent thinking (?, φ, ¡, α) "is" or "is not." And once this is settled, the mind moves to an evaluative thinking where it deliberates and judges its validity accordingly. Once done so, we move towards the 4th level where we ask if then the value so established is worthwhile pursuing, that is, is a true value and so decide to embody it or not.

From such a process-wise description the reader shouldn't infer that the operations happen likewise. The operations of experiencing, imagining, understanding, conceiving, judging, deciding, and executing configure a dynamic structure of interrelated parts, but not of happenings of sequential nature.

Such a model of the structure and dynamism of human knowing allows now two qualities that AI, as existent contemporary, doesn't entail. The first, to the operations of the mind being transitive, that is they have objects, by which we become aware of the object. We "intend" when we as operators operate. Our operating is intentional; there is intentionality in the process of knowing. And so, by seeing, what is seen becomes present; by hearing, what is heard becomes present; by imagining what is imagined becomes imagined.

Secondly, the operations are performed by an operator that is named: subject. Any person in his right mind (and senses), not asleep nor in a coma, is aware of himself operating; is present to himself operating, experiencing himself operating. Furthermore, the quality of consciousness changes with different operations. So here are grounds where AI in its actual form seems to be distant from insight, intention, and consciousness.

> The operations then not only intend objects. There is to them a further psychological dimension. They occur consciously and by them the operating subject is conscious. Just as operations by their intentionality make objects present to the subject, so also by consciousness they make the operating subject present to himself [...] Just as we move from the data of sense through inquiry, insight, reflection, judgement, to statements about sensible things, so do we move from the data of consciousness through inquiry, understanding, reflection, judgment, to statements about conscious subjects and their operations. (Lonergan, 1990, pp. 8–9)

Which is precisely what is being done now: making statements about conscious subjects and their operations.

Here too, distinct levels of intentionality and consciousness are found that are related amongst them and with the levels of operations mentioned above. While sleeping and in dreams our intentionality and consciousness is fragmentary and incoherent. But when awake, said intentionality and consciousness becomes *empirical* when seeing, perceiving, imagining, feeling, speaking, and moving. It becomes *intellectual* when inquiring, understanding, expressing what we have understood, and working out the presuppositions and implications of our expression. *Rational* when reflecting, marshaling the evidence, passing truth or falsity, certainty, or probability of a statement. Finally, in the 4th level, there exists an intentionality and consciousness that can be referred to as *responsible*, by being concerned with ourselves, our operations, our goals and deliberating about choices, evaluating them, deciding and executing our actions.

Intentionality and consciousness that although related, manifest different dimensions amongst levels and within each level with respect to the operations.

> Our consciousness expands in new dimensions when from experiencing we turn to the effort to understand what we have experienced. A third dimension [that] of rationality emerges when the content of our acts of understanding is regarded as, of itself, a mere bright idea and we endeavor to settle what really is so. A fourth dimension comes to the fore when judgement on the facts is followed by deliberation on what we are to do about them. On all four levels, we are aware of ourselves, but as we mount from level to level, it is a *fuller self* of which we are aware and the awareness itself is different. (Lonergan, 1990, p. 9)

TRANSCENDENTALS

Another of Lonergan's notions that encompasses his notions of operations, intentionality, and consciousness is that of transcendentals contained in questions prior to the answers. This further notion will allow to understand better the place of AI, its capabilities and restrictions, within the complexity that the structure and dynamism of operations that finally allow us to be human and emerge as persons. Yes, because most of the discussion about AI compares only to what is known about the mind and the meanings that authors ascribe to intelligence. Human beings are not only "walking and sensing minds" but are *persons*. This being an elusive notion not yet agreed on.[5]

Transcendentals, for Lonergan are

> the radical intending that moves us from ignorance to knowledge. They are *a priori* because they go beyond what we know to seek what we do not know yet.

> They are unrestricted because answers are never complete and so only give rise to still further questions. They are comprehensive because they intend the unknown whole or totality of which our answers reveal only part. So, intelligence takes us beyond experiencing to *ask what* and *why* and *how* and *what for*. Reasonableness takes us beyond the answers of intelligence to ask whether the answers are true and whether what they mean really is so. Responsibility goes beyond fact and desire and possibility to discern between what truly is good and what only apparently is good. So, if we objectify the content of intelligent intending, we form the transcendental concept of the *intelligible*. If we objectify the content of reasonable intending, we form the transcendental concepts of *the true* and *the real*. If we objectify the content of responsible intending, we get the transcendental concept of *values*, of *the truly good*. But quite distinct from such transcendental concepts, which can be misconceived and often are, they are the prior transcendental notions that constitute the very dynamism of our conscious intending, promoting us from mere experiencing towards understanding, from mere understanding towards truth and reality, from factual knowledge to responsible action. That dynamism so far from being a product of cultural advance, is the conditions or its possibility; and any ignorance or error, any negligence or malice, that misrepresents or blocks that dynamism is obscurantism in its most radical form. (Lonergan, 1990, p. 11–12, emphasis added)

What this is saying is that within us human beings there exists a structure and dynamism of our intentionality and consciousness that operates well above and before the logical operations that, for the time being, characterize AI.

CONCLUSION AND SUGGESTIONS FOR EDUCATION, NOT ONLY MANAGEMENT EDUCATION

1. Our account of intelligent thinking, reflexive, critical, and evaluative thinking provides a perspective to "rethink, retrain, redesign" education in general. When education is a matter of combining both a developing learning process with a commitment to teaching learning, we can rethink learning as the result of a subject's reflexive application of critical to intelligent thinking, and teaching as a concomitant orientation of a professor's critical thinking to the intelligent thinking of a community of learners—his/her students.

   The last figures (Figures 3.4 and 3.5) sum up our teaching to learn proposal in the actual context of growing data and information accessibility. Teachers, because of their familiarity not only with data and information of their disciplines, but with knowledge, can aid their students critical and evaluative thinking by instilling in them the *when, how,* and *why* for the students to formulate the appropriate questions.

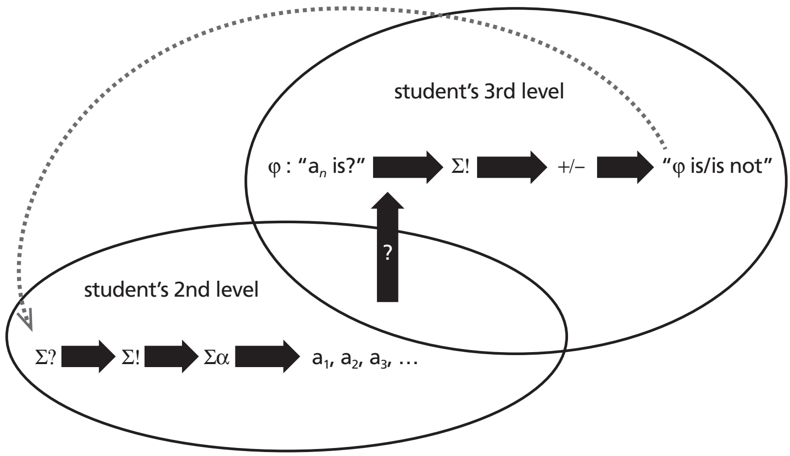

Figure 3.4 Developing learning.

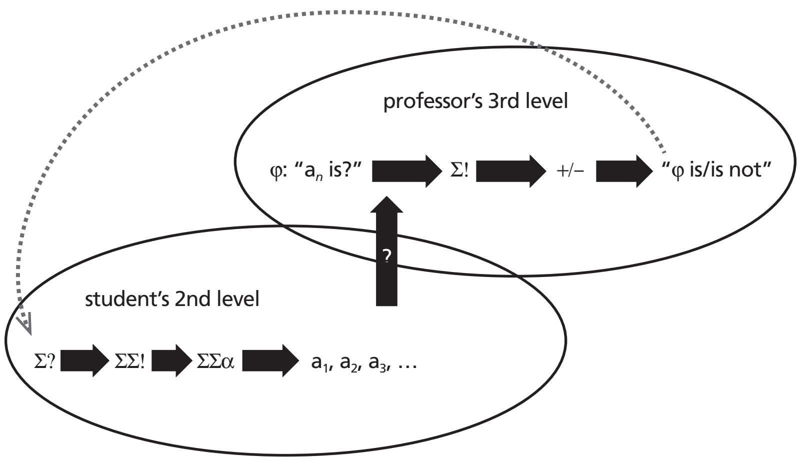

Figure 3.5 Teaching developing learning.

2. With ever growing general and specialized search engines, data, and information the once prominent role of higher education of information generator and deliverer has receded. What is left then for higher education? Heidegger opens a door for us.

    At the end of the 1950s, Martin Heidegger observed a process underway of thought-poor and thoughtlessness.

> For nowadays we take everything in the quickest and cheapest way, only to forget it just as quickly, instantly [. . .] But even while we are

> thoughtless, we do not give up our capacity to think. We rather use this capacity implicitly, though strangely: that is in thoughtlessness we let it lie fallow." (in Solomon, 1974, p. 121)

And this is so because we have reduced thinking to what he calls *calculative* thinking:

> Its peculiarity consists in the fact that whenever we plan, research, and organize, we always reckon with conditions that are given. We take them into account with the calculated intention of their serving specific purposes. Thus, we can count on definitive results. This thinking is the mark of all thinking that plans and investigates. Such thinking remains calculation even if it neither works with numbers nor uses an adding machine or calculator. Calculative thinking computes [...] races from one prospect to the next [...] never stops, never collects itself. Calculative thinking is not *meditative thinking, not thinking which contemplates the meaning which reigns in everything that is.* (Solomon, 1974, p. 122, emphasis added)

Detractors of this meditative thinking claim that "it finds itself floating unaware above reality. It loses touch. It is worthless for dealing with current business. It profits nothing in carrying out practical affairs" (Solomon, 1974, p. 122). But the truth of the matter is that at times it requires greater effort, for one can intuit that it is the fallow ground where insight takes place.

For Heidegger both types of thinking are justified and needed in their own way, because human beings are thinking and meditative beings.

We need then to discover the conditions, the tools, the pedagogy that allow us to offer students ways to be exposed to both types of thinking, knowing that AI's growing ground is calculative thinking only.

3. The university's population needs to understand science and its method well, not only by those undergraduates that contemplate being researchers and workers in the natural sciences, but by every future graduate to understand and place properly all the developments and artifacts produced by AI. Be it that they will need to interact with said artifacts or required to develop them further, they need to know the impact these will have on themselves, their teams, the organization in general, but too, within their social relations: friends and family. Being aware of science and its method will provide the limitations and potentialities of AI artifacts, since these are a product of science's principles and laws that feed present technological innovations.

4. AI and its frequent innovations need to be understood too. On the one hand, the example mentioned above about how logarithmic tables, slide rules, calculators, and computers changed the "computational landscape." On the other, the entrepreneurship, work, family, and social transformation of the industrial revolution, both should warn us about how economic opportunities and technology affects work, family, and society. The only difference nowadays is with respect to the time threshold. It took 400 years from Napier's logarithmic tables to put a man on the moon. And about two hundred to dissolve the working household and affect the family in its essence and grow wealth in unthought proportions and inequality. Today telework from home plus the internet of things keep some of the members of the household at home permanently, but some become solitary and paranoid about security outside of its precincts.
5. Graduates need to know the conditions that make them human. Despite all the fast pace of knowledge about the corporal and psychological underpinnings of our life as humans, instructors and students cannot obviate asking the question and providing for themselves answers about such basic knowledge. Difficult questions and answers—the building blocks of critical and evaluative thinking—need to be formulated all along our life.
6. Basic human qualities of thought, dialogue, empathy, and love need to be cultivated. The unfortunate jargon of hard and soft skills needs to be transformed into qualities and character strengths that all-round persons embody. Otherwise the frequent relation with AI artifacts will disembody the humanness of its users and lose our hard gained autonomy as persons.

NOTES

1. Since the 16th century logarithm tables and slide rules have aided computations. Mechanical adding machines were popular in the 19th century; mainframes appeared in the 1950s; electronic calculators in the 1960s; and at the end of the 1970s personal computers. All those calculating inventions, as they appeared, would displace the jobs of people who earned a living by performing computations with the previous device and demand new skills. Nevertheless, the overall lesson has been that human intelligence is more than a calculating mind. Too, neither did the web usurp man's intelligence nor communication. Social media nor virtual relations substitute face to face interaction fully. Up to now, technology has aided man's development and brought to the fore human qualities unforeseen in the past. On the other hand, unanswered questions will always be present regarding the technological developments that warfare brought in its wake: chemistry, physics, biochemistry,

nuclear energy, and so forth; or present follies (massive unemployment in the retail sector, dodging government control, eroding trust) created by the Information Age giants and AI innovators: Amazon, Apple, Facebook, Google.

2. If in the will we include the "heart" as the seat of our emotions, we can bear in mind Pascal's thought: "The heart has its reasons of which reason knows nothing" (Pascal, 1950, p. 33).
3. Good old fashion artificial intelligence.
4. Pain is a very basic "experience." It has been researched from all disciplines. New discoveries on locations of the brain where different sorts of pain take place have given way to algorithms (AI) that measure the true intensity of pain. The hope is that AI somehow can aid eliminating pain. It will be the experience we concentrate on in this chapter, rather than the usurping of intelligence or power that is frequent in AI doomsday literature.
5. A very dramatic example is that of abortion. Millions of beings are aborted yearly all over the globe on account of not agreeing if they are human persons or not. It is a standing issue and will always be on account of most world religions agreeing that from the moment of conception a human being, a person, is given existence.

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CHAPTER 4

ARTIFICIAL INTELLIGENCE AND FRUGAL INNOVATION

A Formidable Alliance in Future Education

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Our planet is increasingly facing troubling times with worrying trends in food (in)security, poverty, inequality and climate change making daily headlines. Companies, large and small, as well as individuals, are waking up to the call for frugal living and frugal consumption. Making an effective and fast transition from being resource intensive, polluting, and irresponsible to the opposite has become a matter of great urgency for the survival

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of all species. Efforts for achieving sustainable growth are seen by many as a frugal innovation (FI) revolution where the emphasis is to do better with less (Radjou & Prabhu, 2016).

To achieve this, Prakash (2018) proposes that companies must "reinvent themselves as frugal enterprises that integrate digitally empowered consumers, addressing their needs in a more valuable and cost-effective way" (para. 1). Artificial intelligence (AI) is one of the frontier digital technologies that will shape our future more powerfully than any other innovation this century, in particular, in the way that it will enable FI in delivering formidable solutions (Zhang, 2003). Rao (2017) refers to this combination as advanced FIs that will achieve even greater sophistication in the foreseeable future, playing a big role in the fourth industrial revolution, also described as the intelligence revolution (Wright, 2018).

This chapter identifies how AI can enable and enhance FI to deliver cost-effective solutions to potentially billions of people, in particular those at the base and middle of the income pyramid. In layman's terms, FI is when companies innovate throughout the entire value chain to develop products or services for customers who either cannot afford the current premium offerings and/or do not desire its unwanted features. The end result is offerings characterized by a substantial reduction in price and/or total cost of ownership/usage, a focus on core functionalities, and optimization of performance level to meet the exact needs of target users.

A key motivator in developing AI technology, where machines perform human-level cognitive functions, is to extend human capabilities and improve the quality of life. Through a number of case studies from a diverse range of industries this article demonstrates how AI is helping frugal innovators to develop solutions that were previously not available or affordable to disadvantaged people. From this it is speculated on how the AI/FI partnership could potentially influence the development of cultures specific to education and training, in particular focusing on end users that are constrained in physical or financial ways.

Overview of Artificial Intelligence

In the 18th century, the Industrial Revolution began, and it changed the way we, humans, lived and operated businesses in dramatic ways. It is what paved the way for a lot of the infrastructure and technological developments that we experience today. We began manufacturing in much more efficient and economical ways, increasing profits and growing a booming economy that has not looked back.

Today, we are in the midst of a digital revolution that is in full swing, and a particular technology is playing an increasingly important role in this revolution—*artificial intelligence*. Artificial intelligence, or AI for short, was a term coined in the 1950s by a group of scientists, including the late Marvin Minsky (1968) who defined AI as "the science of making machines do things that would require intelligence if done by people" (p. v). This highlights a key aspect of AI that is different to the automation of tasks that we have experienced for over 50 years now—instead of automating just the repetitive, monotonous tasks, we are now automating tasks that once required human level intelligence such as driving a car, operating an aircraft, observing crowds for suspicious behaviours, trading the stock market, and so on. This has profound impact on society, on our lives, our jobs, our economy, and indeed our very future as humans.

As mentioned, the concept of AI in computing has been around for over a half a century now, the early promise of AI hit roadblocks when scientists and investors realized that the computational hardware could not support what was needed to make AI practical. Around 2010, the thirst for AI was reignited with some of the big tech companies making significant steps towards it, such as the Google Brain project that started in 2011 and IBM's Watson that beat human champions in the quiz game Jeopardy in that same year. Since then, AI has taken off at a dramatic speed driven by two main factors and an emergent third.

The factors that have enabled the recent rapid progress of AI are: the abundance of *data* from all sectors that were digitized many years ago, in particular the explosion of the social media; the dramatic increase in *computational power* that allows AI techniques to be applied to the data available; and more recently the *prolific investments* made by companies (Mercer & Macaulay, 2018) and governments (e.g., France's $1.5 billion pledge to boost AI [Olson, 2018]) alike in advancing the algorithms and hardware needed to advance AI techniques.

Unlike the industrial revolution that created more jobs than it took away, the AI revolution is predicted to take away more jobs than it would create unless we rethink how we skill our future workforce. For example, a recent report from global management consulting firm, McKinsey, on the effects of automation and AI on jobs, skills, and wages for the period ending in 2030 (Manyika et al., 2017) estimates that between 400 million to 800 million individuals could be displaced by automation by 2030 and that up to 375 million people may need to switch occupational categories. The report however does suggest that as in the past, labour markets will adjust to meet demands for workers.

It should be noted however, that the significant progress in AI has been on task specific AI, or what is commonly referred to as *narrow* AI. All the examples mentioned in the section such as playing Jeopardy, financial trading, or even driving a car fall under this category. The other category, *general* AI, is the more futuristic AI that is often depicted in movies and television shows such as Westworld (https://www.hbo.com/westworld) where machines are afforded human level intelligence to perform any generalized task it is given. This has proven to be a near impossible task and it is fair to say it is well beyond current technology. There are some key features in humans that are extremely difficult to replicate in machines, such as human level understanding, empathy, intuition, emotional intelligence, to name a few. Yet, these features are not required for the millions of applications using AI, such as image recognition for example, a machine can be trained to find answers on the web via intelligence pattern matching without understanding what the question is really asking.

What we have seen is that AI, and technology in general, is built to enhance and extend human abilities rather than replace humans. In fact, it has been shown that the best Chess players are neither human nor machine but the combined team of human and machine (Cassidy, 2012). More and more technologies and industries will be looking to harness the power of human–machine collaboration into the future.

Overview of Frugal Innovation

This section provides a more in-depth overview of FI and its various attributes and uses. It being a relatively new phenomenon that only started taking shape in the last decade, the meaning of FI is still fuzzy (Weyrauch & Herstatt, 2016).

Prior to the inception of FI the prevailing mindset of international developed market firms (IDMFs) was to develop sophisticated and state-of-the-art products mainly for Western markets where businesses and consumers are affluent (Zeschky, Winterhalter, & Gassmann, 2014), hence able to afford such offerings. These companies simply did not perceive it sufficiently profitable and worth the effort to serve customers in emerging and developing markets with products and services aimed at meeting their specific needs and matching their unique conditions. At best, they would serve these markets with "glocalization" strategies, that is, the adaptation of international products around the particularities of a local culture in which they are sold (Robertson, 2012) to the so-called "haves." Not surprisingly, such attempts met with very limited success as only a very small privileged minority can afford such products, hence the "have nots," or resource-constrained consumers as they are also known, remained largely underserved or worst case, unserved. Resource-constrained, in this context, implies market conditions where material resources, time, and affluent customers are scarce (e-Cunha, Rego, Oliveira, Rosado, & Habib, 2013). As more than half the world population find themselves at the base of the pyramid (BOP) where people live on an income of under $1 USD per day (Prahalad & Hart, 2002), this is indeed a dire situation.

Various scholars hold differing opinions about the commercial attractiveness and feasibility of BOP markets. Some regard it as a multitrillion-dollar opportunity that provides great opportunities for product developers (Angot & Plé 2015; Varman, Skålén, & Belk, 2012), while opponents to this view (Karnani, 2007) refer to it as the "misfortune at the BOP" (Pervez, Maritz, & de Waal, 2013), suggesting very limited market opportunity. Despite the negative perceptions, today many multinational corporations (MNCs), such as General Electric and Siemens, increasingly view FI as a viable product innovation strategy for new and untapped markets (de Waal, 2016) while international conglomerates such as the Tata Group (India), as well as a plethora of small and medium-sized enterprises (SMEs) and start-up ventures in emerging and developing markets very successfully exploit local frugal opportunities.

Until recently, FIs were mainly associated with emerging and developing markets, but they are now adapted and purposely created for developed markets. Adapted FIs that trickle their way upstream into mainstream and/or marginalized Western markets by capturing the attention of cost-minded customers, are referred to as reverse innovations (Zeschky et al., 2014). Roland Berger Strategy Consultants identify new and fast-growing customer segments in mature Western economies that become cost conscious and no longer desire the unwanted features often associated with premium products (Roland Berger, 2015). They predict that 4.8 billion people will belong to the global middle class by 2030, hence the race is on to capture this fast-growing customer segment with FIs. Already, the media frequently report success stories in these markets (Radjou & Prabhu, 2014).

But what are the origins of FI? Carlos Ghosn, chairman and CEO of the Renault-Nissan Alliance, first coined the term *frugal engineering* in 2006, explaining it as a systematic [process] approach to product development with the aim of making the underlying constraints irrelevant, or at least less important than in the conventional approach to engineering (Simula, Hossain, & Halme, 2015, p. 1568). Taking an outcome view as opposed to a process view, many scholars have come up with slightly different definitions that essentially say the same thing (Hossain, 2018). Here, the views expressed by scholars at the Centre for Frugal Innovation at the Hamburg University of Technology are adopted, who describe FIs as

> those innovative products, services, or processes which seek to create attractive value propositions for their targeted customer groups by focusing on core functionalities and thus minimising the use of material and financial resources in the complete value chain. They substantially reduce the cost of usage and/or ownership while fulfilling or even exceeding prescribed quality standards. (Tiwari, Fischer, & Kalogerakis, 2017)

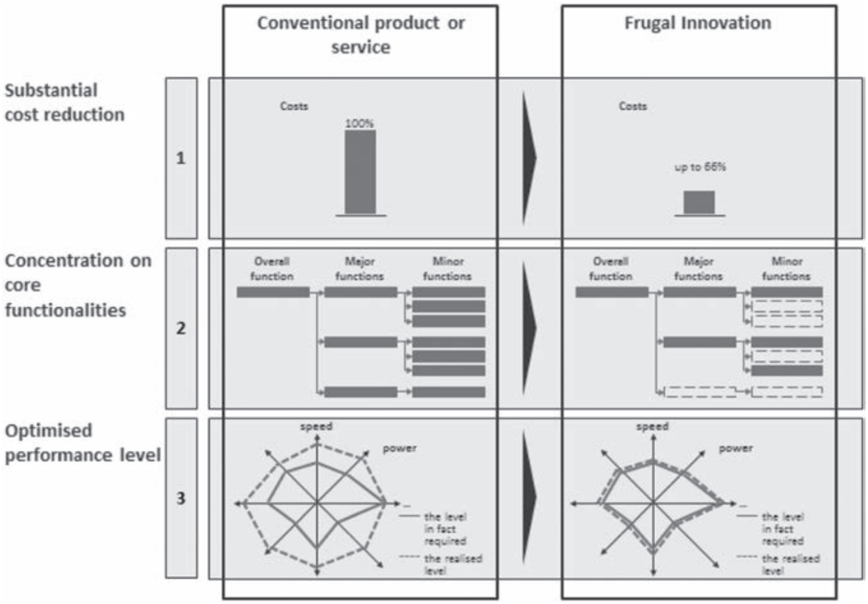

Figure 4.1 The three defining criteria for Frugal Innovation. *Source:* Weyrauch & Herstatt, 2016.

Aligned with this definition, Weyrauch & Herstatt (2016) describe the three core criteria of frugality that must be simultaneously met, depicted in Figure 4.1, as: (a) substantial reduction in price and total cost of ownership/usage (at least one third from a customer perspective), (b) focus on core functionalities (that are in fact required for its specific purpose and local conditions), and (c) optimization of performance level to meet the ever-changing needs of target users. Often, though not always, frugal innovations fulfil the same basic purpose as an existing first-world or conventional product, but are purposely engineered for frugal customers. They often constitute radical innovations and may contain disruptive elements.

From a review of the literature, the authors found that within the three criteria or categories of frugal innovations, specific attributes (Table 4.1) strongly depend on and vary according to a specific context. For example, when comparing emerging markets with developed markets, the specific local conditions such as infrastructure, culture, and customer habits will demand different attributes from frugal innovations to best meet customers' specific needs and intended purpose.

TABLE 4.1 Categories and Attributes of Frugal Innovation

Substantial cost reduction	Considerably lower initial cost of purchase price; reducing the total cost of ownership; minimising the use of material and financial resources; affordable; co-creation
Concentration on core functionalities	Functional and focused on essentials; minimising the use of material and financial resources; user friendly and easy to use; simple
Optimised performance level	Reliable; robust; high-end technology; maintain quality; fulfilling or even exceeding certain pre-defined criteria of acceptable quality standards; sustainable; eco-friendly; appropriate; adaptable; accessible; social benefit; portable; leapfrog technology; service ecosystems

Source: Adapted from (Weyrauch & Herstatt, 2016); additions from (Lehner & Gausemeier, 2016) and (Roland Berger, 2015)

Artificial Intelligence and Frugal Innovation

A key principle in FI is to take what is in abundance and produce what is scarce. One of the key drivers of AI is the abundance of data and the ease and economical ways in which data can be collected. The amount of data produced is doubling every 2 years and by 2020 the digital universe is expected to grow to 44 trillion gigabytes (Zwolenski & Weatherill, 2014)!

Artificial Intelligence techniques employed to process and analyse the data requires high performance computer hardware which today is available via cloud-based infrastructures that could service a wide-range of data processing via time sharing, for example. So, it is possible to develop innovative frugal technological solutions incorporating AI to solve problems. Section 3 presents some examples of such FIs.

Advances in AI have seen the creation of affordable and accessible technology that would otherwise be out of reach for most people. For example, virtual training environments, as there are affordable virtual reality headsets and even the latest smartphones today are equipped with augmented reality capabilities. This allows affordable and scalable training simulators to be developed for a wide variety of sectors.

Augmented and virtual reality coupled with AI software, are used in education and there are new and innovative technologies that are emerging. For example, the education company Pearson, has teamed up with Microsoft to produce an app that uses holograms of patients to train nurses that use Microsoft's Hololens to project the holograms. The app provides a series of digitally created healthcare scenarios, where students interact with professional actors pretending to be ill and learn how to diagnose and treat them. This would be resource intensive and not easily accessible if real human participants were to be used. What would make these affordable systems more effective is in the use of AI techniques that control the behaviors of the virtual patients and adapt scenarios personalized to the individual student's learning abilities.

CURRENT ARTIFICIAL INTELLIGENCE AND FRUGAL INNOVATION SOLUTIONS

Artificial Intelligence has wide applicability and can be used virtually in every sphere of life (Nassiri-Mofakham, 2017). It has been deployed in contexts such as the health service, education, cyber security, law (Jiang et al., 2017), transportation, energy, e-commerce, customer care, business strategy, and virtual assistance (Srivastava, 2018). We next discuss how three companies in the transport, water supply, and medical industries have integrated AI technologies in frugal products that are transforming lives and impacting whole communities for the better.

Case Study 1: Twende-Twende (Let's Go) App

Twende-Twende is an intelligent transportation system (ITS) that extends the Traffic Awareness System (TAS) to cater to the specific needs, preferences, and constraints of Nairobi drivers.

The End User Problem

Nairobi, a city with just over 3 million inhabitants, has an enormous traffic problem that is estimated to cost them $600,000 per day (Ehrlich & Fu, 2015). Many sources cite it as one of the top five congested cities in the world, and arguably sitting at top spot in Africa (Mutavi, 2017). While the size of the population is far from excessive compared to other world cities, several factors contribute to Nairobians spending, on average, 62.44 minutes in traffic during weekdays. At the core of the problem is the poor design of Nairobi's aging roads, with as many as eight lanes on the city's outskirts feeding into fewer lanes towards the city center, causing bottlenecks. Add to this, a lack of a proper and organized public transport system in the city that increases the number of personal vehicles to such an extent that the city's road structure must cope with ten times the amount it was designed for. In addition to the loss in economic productivity and increased fuel consumption, the congestion problem is a huge contributor to environmental pollution. These problems are exacerbated by economic constraints, dynamic events, uncertainty in traffic environments, limited road information (most streets are unnamed), and poor infrastructure (Kinai et al., 2014).

Infeasible Traditional Solutions

Elsewhere in the developed world, the problem of increased urbanization is dealt with through the development of new roads and infrastructure. For Nairobi, however, this was and still is not a feasible option as the required investment in construction is exorbitant and prohibitive. Other significant challenges include the complex design and build of such schemes.

Bricolage: Making Do With What Is At Hand

Given the very limiting constraints, the quest was on for a cost-effective solution that would significantly ease traffic jams in the streets of Nairobi. In modern cities facing congestion problems, traffic systems have been deployed utilising existing infrastructure such as state-of-the-art cameras, satellites, and social media to estimate traffic density. Commuters can access the processed information and recommended routes in real time to minimize travel time. In Nairobi, the major technical barriers were the existing ultra-low-resolution city cameras in use which made image processing by computer extremely difficult, and their limited reach. Only 5% of the roads were covered in 2013. The million-dollar question was how to integrate this almost obsolete, legacy technology in ways to deliver similar outcomes than those obtained from high-tech platforms in modern cities.

The AI Side of the Solution

To accurately estimate traffic flow, IBM Tokyo Research developed network flow algorithms to process and analyse the data captured by the city's low-resolution cameras. This technology was complemented with a mobile app called Twende-Twende, which is Swahili for "let's go." It incorporates locally relevant context such as references to landmarks and user recommendations to predict congestion and create traffic awareness (Ehrlich & Fu, 2015). Commuters are informed via free text messages of real-time traffic conditions and the best routes for avoiding traffic jams.

The Frugal Innovation Side of the Solution

Smart cities utilize numerous systems of intelligent subsystems to ultra connect people and organizations, thus providing them with quality products and services that result in sustainable socioeconomic development (Voda & Radu, 2018). By any stretch of the imagination, Nairobi is not a smart city. It is impossible to associate any of the smart city characteristics such as "ubiquitous ICTs applied to critical infrastructure components and services" (Washburn et al., 2010, p. 124), smart economy, smart governance, smart living, and smart environment (Giffinger & Gudrun, 2010) with Nairobi. As the capital of a developing African country, it is instead characterized by all five of the so-called needs gaps that separate emerging markets from rich countries (Govindarajan & Trimble, 2012). The needs gaps are expressed in terms of performance, infrastructure, sustainability, regulatory, and preference.

Conclusion

Below we indicate how the Twende-Twende solution succeeds in "leapfrogging" the first three needs gaps by simultaneously satisfying all three criteria (see Table 4.1) of FI. We discuss the specific attributes alongside each criterion.

1. Substantial cost reduction. While Nairobi does not necessarily aspire to become a smart city, through the combined use of AI and frugal innovation as manifested in the Twende-Twende app, the city succeeded in crossing the infrastructure gap by transforming its very problematic mobility situation into a smart solution. They achieved this through inexpensive utilization of their old legacy system that delivers very low-quality images (VLQI), sidestepping the need to heavily invest in state-of-the-art cameras. Even though estimates of cost saving are not known, there is little doubt that this approach saved the city millions of dollars. Clearly, the Twende-Twende app demonstrates the principles of minimizing the use of material and financial resources in delivering an affordable solution to the city of Nairobi and its road users.

2. Concentration on core functionalities. The Twende-Twende app was purposely designed for the city of Nairobi after meticulous research into the specific needs of road users (Kinai et al., 2014). The incorporation of local context such as land marking, the choice of social media for live user recommendations, the type of information required and the desired accuracy of the system, are all examples of the emphasis placed on desired functionality and a focus on essentials. The unique combination of legacy combined with state-of-the-art technologies demonstrate the frugal principles of minimizing the use of material and financial resources. Finally, through ongoing and in-depth consultation with app users, the aim of achieving a user-friendly service has been widely acknowledged (Kinai et al., 2014).

3. Optimized performance level. Despite only having had access to data extracted from 36 low-quality traffic cameras at some key points in the city, IBM researchers developed a reliable model of how key "forks in the road" would predict all other roads (Kinai et al., 2014). With the help of AI technology, these researchers were able to leapfrog the need for installing expensive ICT technologies that are required by similar traffic systems in modern cities. Using and adapting what was already available on the ground, combined with the power of AI, this frugal solution achieved acceptable quality levels and comparable performances than premium traffic systems in operation elsewhere. As such, it is a great example of AI and FI combining effectively to help close the performance gap in this developing country. Though difficult to measure the resulting improvements in air quality, there is little doubt that Twende-Twende plays a part in closing the sustainability gap.

Case Study 2: OxWater

OxWater is a spin-out company implementing new technologies, models, and analytics to deliver sustainable water systems in Africa and Asia.

The End User Problem and Ineffectiveness of Traditional Solutions

Millions of people around the world still lack sustained access to essentials such as clean water and electricity. This is particularly an issue in the continent of Africa, mainly in rural locations. Millions do not have indoor plumbing, instead, they rely on hand pumps to access groundwater. These hand pumps malfunction and break down over time and it is estimated that one-third of pumps are not functioning at any given time (RWSN Executive Steering Committee, 2010). Due to lack of resources, know-how, and managerial expertise of the local communities, they often do not get fixed. This severely affects the communities, especially women and girls who would have to travel further to find water.

Frugal Innovation Utilizing Enabling Digital Technologies Including Artificial Intelligence

OxWater (http://www.oxwater.uk/), a startup launched from Oxford University, has come up with a frugal solution that utilizes basic mobile phone technology, smart sensors, and smart algorithms, including AI techniques, to address this issue. In a nutshell, they build and deploy low-cost *smart* hand pumps, that houses simple and inexpensive sensors and a transmitter in the handle of the pump (Thomson, Hope, & Foster, 2012). The sensors capture data such as the motion of the handle, volume and flow of the water pumped which is then transmitted via regular SMS text messages to a central data server for processing. The data is analysed via smart algorithms, incorporating AI techniques. If a pump fault is detected, a local, trained repair team receives a notification to fix it. The AI techniques also afford predictions of which pumps are likely to break and reports low groundwater levels.

Following a successful prototype in 2011, the first operational smart hand pumps were installed in Kenya in 2012 as an operational trial. After a year-long trial the results showed that this frugal innovation was able to significantly reduce the hand pump downtime from 27 days to under 3 days, with 98% of the hand pumps working at any given time compared to the 70% prior to commencing the trial (Smith School of Enterprise and Environment, 2014).

Other Benefits

In addition to the above, as the number of smart hand pumps scales across the continent, the data collected from each individual pump could be transformed into a large-scale, distributed shallow groundwater monitoring network (Colchester, Marais, Thomson, Hope, & Clifton, 2017). This will address a global challenge for solutions that enables timely and cost-effective groundwater monitoring, in both industrialized and developing countries. This in turn could enable action to protect water supplies and improve management of a resource that is under increasing pressure.

They do this by using the handle movement data sent from each pump and use robust machine learning techniques that are sensitive to the subtle interaction between the dynamics of the hand pump and the underground aquifer beneath the pump to estimate the water level.

Conclusion

The smart hand pump solution is an excellent case study of FI empowered by AI that is solving problems that impacts millions of lives. As mentioned a key feature of all frugal technology is taking what is in abundance and enabling what is scarce. What is scarce here is the clean water coupled with the resources required to monitor the 200 million hand pumps across Africa, the knowledge on how to service the devices and the resources and expertise to monitor the ground water levels which is a precious commodity, especially in that part of the world. The solution was to take advantage of what was growing in abundance at that time—cell phone technology, which has grown even more today. As a quote from a CNN report in 2016 puts it—"In Africa, less than one in three people have a proper drainage system, half of the population live in areas without paved roads, and only 63% have access to piped water. Yet, 93% of Africans have cell phone service" (Parke, 2016, para. 1). The low-cost sensors that allow data to be gathered at scale, provides an abundance of data that is generated and transmitted at hourly intervals to a cloud-based server. The advanced artificial intelligence computation completes the solution in providing the techniques for processing and analysing the data and generating the required reports.

Case Study 3: SigTuple

SigTuple (https://sigtuple.com) is a private limited company based in Bangalore, India. It was co-founded in 2015 by Rohit Kumar Pandey who is the CEO (Crunchbase, 2018). The company has 17 investors and employs between101 to 200 people (PitchBook, 2018).

Using sophisticated machine learning techniques, SigTuple builds intelligent solutions to perform medical testing thus their vision is to disrupt the medical diagnostic space by data driven intelligence. Its mission is to create a data driven, machine learned, cloud-based solution for the detection of anomalies and trends in medical data using deep learning, which improves the accuracy and efficiency of disease diagnosis.

The End User Problem

SigTuple addresses the challenges of a shortage of doctors practising in distant regional areas, and ineffective as well as inefficient medical screening. By using remote diagnosis for blood, urine, and semen tests, the company is able to expand access to health care to a wider clientele as it enables doctors to assess patients and testing remotely (Takahashi, 2017). The company's core business is the provision of machine-learning based healthcare through its management platform known as "Manthana" which is designed to detect health anomalies through medical testing. Manthana aids diagnosis utilising an AI-powered analysis of visual medical data, and this enables clinicians to improve accuracy in disease diagnosis (PitchBook, 2018).

Manthana offers the following five solutions:

- Shonit, which is a complete peripheral blood smear analyser solution;
- Shrava, which performs a urine analysis test to detect substances;
- Aadi, which provides a semen analysis solution;
- Dhrishti, which detects the fertilization ability of sperm; and
- Vaksha, which conducts a chest X-Ray analysis.

The Artificial Intelligence Side of the Solution

SigTuple is a classic example of a company that uses AI in the provision of healthcare services. Through their Manthana platform, the company uses AI to dramatically improve the speed, accuracy, and consistency of various screening processes thus enabling doctors to serve more patients with higher accuracy (SigTuple, 2017). By applying knowledge, skills, and intelligence (Srivastava, 2018) the clinical screening services provided by SigTuple through the use of the microscope, cell phone, and cloud technology, are services that were performed by human beings and may be classified as AI.

The Implementation of Frugal Innovation

SigTuple's core business provides sound examples of FI conditions. For example, the first condition pertaining to the "relative to cost reduction" is demonstrated in the cost reduction of a blood test. In India, the cost of a blood test ranges between $4 to $10. Instead, SigTuple charges between 40 cents to 80 cents, representing a massive 90% and 92% cost reduction, respectively (Takahashi, 2017).

The second "concentration on core functionality" condition is demonstrated through SigTuple as being basically, and essentially, a medical diagnostic service provider with a focus on providing an insightful and interactive report to medical specialists whilst ensuring that their services are vastly affordable and accessible to the masses (SigTuple, 2017).

With respect to the third "optimal performance" condition the company aims at dramatically improving speed of medical tests, accuracy, consistency, and wider accessibility of medical diagnostic services (Takahashi, 2017) to its clients.

Conclusion

Through its Manthana platform, SigTuple is an exemplar of the concepts of AI and FI as it has automated it medical diagnosis, a service perceived as requiring intelligence when performed by humans (Mehta & Devarakonda, 2018; Srivastava, 2018). In this regard, SigTuple's technology qualifies it to be referred to as a company engaging AI in its business practices.

Frugal innovation requires that an innovation must lead to substantial cost reduction, concentrate on core functionalities, and optimize performance (Weyrauch & Herstatt, 2016). SigTuple's approach to innovation meets these requirements as it is focused on core functionalities and reduces medical tests' costs by more than 90%. Furthermore, it dramatically improves the speed, accuracy, consistency, and accessibility of medical diagnostic services to local and remote clients.

CASE STUDY CONCLUSIONS

Apart from meeting all three criteria of FIs simultaneously, the cases described above share other important commonalities. Very noticeably is that their impact is huge, improving the lives of millions of people. Because the services and products are offered at affordable price-points, their uptake spreads rapidly among those markets and populations that previously had to go without.

When developing frugal solutions, our cases indicate that in certain contexts, specifically lacking supporting infrastructure, the intertwining of "bricolage" practices with state-of-the-art enabling technologies, such as AI, is key to success. In new product development (NPD), the principle of bricolage is likened to jazz musicians who are known to improvise on the spot. In similar fashion, NPD practitioners "examine and query the raw materials available and entice some order, creating unique combinations through the process of working through the resources he/she finds" (Barrett, 1998, p. 619). When approaching NPD in this manner, practitioners take a pragmatic approach to identifying and adapting resources, and hence fashion novel responses that are unique to specific contexts (de Waal & Knott, 2013). Neither the low-quality cameras (Twende-Twende) nor the existing poor-performing hand pumps (OxWater) were discarded when the improved solutions were developed. Instead, they formed integral parts of the resulting frugal solutions. In regards to SigTuple, the development of the Manthana management platform was developed to target accuracy in disease diagnosis which reaches into regional areas thereby overcoming lack of infrastructure. When AI and FI form special alliances as observed in our cases, we take the analogy of jazz musicians further by letting them do live streaming of their music to the masses, instead of only playing to a single, local audience at a time.

Of further importance in the AI/FI alliance is the often flow-on effects, not always intended, that add additional value. On the one hand, this can be attributed to the specific nature of FI where solutions often address a main problem (e.g., traffic jams and broken hand pumps), but at the same time solve secondary problems as well, for example, reducing environmental pollution (Twende-Twende) and being able to schedule preventative maintenance (OxWater). On the other hand, the "abundance" attribute of AI allows for scalability and addressing problems at much higher and sophisticated levels than before, for example, monitoring groundwater levels over huge geographical regions in the OxWater case and in the case of SigTuple accurate disease diagnosis available in regional areas. From this it can be observed that the ability of AI/FI solutions to simultaneously tick several boxes (Table 4.2) in the United Nations' (2018) Sustainable Development Goals (SDGs), which makes it highly worthwhile to pursue.

Finally, for all three perfect harmony between AI and humans can be observed. Both need each other to work. The AI/FI alliance demonstrates the old and new worlds coming together. From the top down, companies offer

TABLE 4.2 Primary and Secondary Impacts of AI/FI Solutions on SDGs

Cases	Main problem and related SDGs	Sub-problems and related SDGs
Twende-Twende	Traffic congestion/Lost productivity/Economic losses *SDG8: Decent work and economic growth*	Environmental pollution/Standard of living *SDG11: Sustainable cities and communities* *SDG13: Climate action*
OxWater	Broken hand pumps/Slow response time in fixing hand pumps *SDG6: Clean water and sanitation*	Unknown levels of groundwater levels/Difficulty in managing groundwater *SDG12: Responsible consumption*
SigTuple	Accurate medical diagnosis *SDG3: Good health & wellbeing*	Tyranny of distance *SDG17: Partnerships for the goals*

the latest technologies, while from the bottom up, end users and consumers bring to the table what is available to co-create and co-deliver optimal solutions. The final section explores how the learnings from these cases can be applied and made relevant to the future of education.

RECOMMENDATIONS

So far in this chapter, the two trending concepts of AI and FI have been introduced. We showed how enterprises are integrating the former as an enabling frontier technology, and the latter as a process for achieving more, or better, with less. In what follows we make some recommendations in how AI and FI can change management and business education.

Rethinking Existing Business Practices

Despite the evidence of some successful advanced FIs, for many the path won't be littered with roses, as both AI and FI have their own implementation challenges. Wright (2018) believes that to date, the focus has been largely on adopting AI as a technology rather than applying it as a tool to solve existing problems. She observes an ongoing widespread lack of understanding among enterprises of the potential benefits for AI to solve real-world business problems. As both the needs of poor consumers and the socioeconomic conditions of emerging markets differ significantly from Western markets, firms wanting to pursue FI as market entry or growth strategies must acquire different sets of technological and organizational capabilities if they hope to be successful. While "best practice" for traditional NPD have been well established over decades of research, only in recent times some inroads have been made to understanding what adaptations in processes, approaches, and managerial mind-set are required for successful FI (de Waal, 2017; Govindarajan & Ramamurti, 2011; Radjou & Prabhu, 2016). Hence the imperative is there for leaders and managers to rethink the required changes in mindset in going from premium offering and first-world focus to advanced frugal solutions that serve the base and middle of the income pyramid segments.

Teaching the "Right" Future Skills to Business Professionals and Students

As the principles and theories of FI are less than a decade in the making, in most countries around the world, with the exception of some leading firms in India, China, the United States, and some European countries, the awareness levels among university professionals in developed countries (Melkas, Oikarinen, & Pekkarinen, 2018) and business executives are very low (de Waal & Tiwari, 2018; Radjou & Prabhu, 2015). Despite this, Radjou & Prabhu (2013) predict that Western firms will increasingly innovate "faster, better, and cheaper—and produce a steady stream of frugal solutions to delight value-conscious customers" (para. 12). But this will only happen by raising the awareness and knowledge among producers in both developed and emerging countries of the benefits of advanced FIs and retraining them in the operational methods and strategies to service the huge and untapped markets in the developing world. This process must already start with today's youth, tomorrow's business leaders. In our schools and universities, we must teach AI and FI and raise social and environmental awareness alongside ethical business practices among our students. It is important for the well-being of mankind that these principles be ingrained in the next generation of product developers. Sadly, as there are still many major corporations around the world that act unethically in their labour practices and working conditions (Patterson, 2018), there is the potential for FI to be constrained by such ethical considerations. It is therefore important that universities educate students about responsible innovation. Delft University of Technology is a great example of a university that is leading in this regard. Their OpenCourseWare on the topic of responsible innovation (https://ocw.tudelft.nl/courses/responsible-innovation/subjects/subject-1/) accompanied by a free textbook that contains all the content covered by the web lectures (TU-Delft, 2017), are great resources.

In higher education contexts, students must be given practical assignments that take them on field trips where they can discover, first hand, what third-world conditions are like and how the needs of frugal consumers are different from their Western counterparts. Many universities have already introduced summer courses where students earn credits by spending time abroad with frugal consumers, co-creating frugal solutions for needing societies. In Melbourne, Australia, for example, RMIT University in strategic alliance with Unbound (https://www.unbound.edu.au/), offer students innovative global education programs that take them to places such as Nepal, India, and Vietnam where they engage with locals in FI projects.

As many universities are quite international in terms of their student body, with many coming from emerging-market countries, Melkas et al. (2018) emphasize the significant unused potential of such students to address FI in terms of them being experts on their home countries, providers of FI networks and training, builders of FI showcases, later contact persons (university students often end up in high positions when they return to their home countries), and as future employees in companies in developing countries. They further suggest attitudinal changes among university staff toward teaching and supervision. Students must initiate collaborative project ideas with NGOs that must be executed in a hands-on manner, with university professors in developed and developing countries working together in a concrete way to solve the problems posed by local industries.

Artificial Intelligence has been a part of the core fundamentals in computer science programs at universities for several decades now. Most of the AI curriculum has been constructed around the most influential and widely used text-book *Artificial Intelligence: A Modern Approach* by Peter Norvig and Stuart Russell (2009; first edition released in 1994 and third edition released in 2009). Typical core topics include, problem-solving with search, automata, logic, planning, intelligent agents, and machine learning. With the growth in AI uptake in industry, more universities have begun AI course offerings, in particular there is a growing number of short courses on AI topics offered by world leading universities such as MIT (Weldon, 2018). There is also a growing number of AI course offerings by online education platforms such as the "Self-Driving Car Engineer Nanodegree" program offered by Udacity (2018). These programs are led by world-leading educators in the field and is often in partnership with industry partners. The ubiquitous nature of AI also opens up the question of how we incorporate AI literacy across all levels of education and not just at the higher education sectors, and there have been some recent proposals (Kandlhofer, Steinbauer, Hirschmugl-Gaisch, & Huber, 2016).

Redesigning Education Using Artificial Intelligence and Frugal Innovation

The higher education sector professes to train graduates so that they are job ready. Therefore, the curriculum that these institutions offer should be consistently designed and updated in order to be current and relevant to successive generations of workers and leaders. Artificial intelligence and FI are mutually compatible phenomena and thus there is a complementarity between the two cutting edge cross-disciplinary concepts. Business programs at both the undergraduate and postgraduate levels require educators to introduce their student cohorts to these complementary notions. The instructional method is conducive to case study analysis and in this way clearly exemplifies theory to practice so as to demonstrate praxis. Case study analysis provides real life learning that has relevance to specific industry and cultural contexts thus user friendly to culturally diverse student classes.

Currently higher education institutions lack the teaching expertise and materials demonstrating the complementarity between AI and FI. Currently, each phenomenon is presented in their respective disciplines of IT and entrepreneurship. To date, no one has presented the notion of integrating AI with FI within their curriculum design or delivery. Thus, it is essential for universities to train teaching staff in this field. Finally, it is no surprise that there is no suitable textbook available in this field.

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CHAPTER 5

THE CASE FOR INCLUSION OF ARTIFICIAL INTELLIGENCE GOVERNANCE IN BUSINESS MANAGEMENT EDUCATION

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Artificial Intelligence (AI) is now on the ascendancy in business, government, and even the nonprofit sector largely because of the accelerated pace of big data analytics (BDA) and internet of things (IoTs; Barzilay, 2017; Meti, 2016). Now that AI is gradually becoming more widely available and harnessed for various economic and noneconomic purposes (Moffat, 2018; West & Allen, 2018), policymakers and other stakeholders are increasingly engaging in debates (Grier, 2018; Mahroum, 2018) on the opportunities, risks and harms of AI-based technologies. Such conversations on AI frequently revolve around policy, legal, ethical, and governance matters (Krigsman, 2017; Singer, 2016).

Management education nowadays puts relatively greater attention to corporate governance (Zuckweiler & Rosacker, 2014), ethics, and integrity

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subsequent to the 2000 Dotcom fiasco and the 2008 global financial crisis (GFC). Education itself, in general, is impacted heavily by AI applications significantly, in particular on teaching and learning in higher education (Popenici & Kerr, 2017). Artificial Intelligence applications are, however, seeing battles between those with utopian and apocalyptic perspectives. The former are buoyed by the recent example of AI beating expert doctors in locating cervical precancers (France-Presse, 2019), and the latter by a global hotel chain mothballing many of its androids because of frequent breakdowns, annoyance to guests, as well as very high maintenance costs (Ryall, 2019). Such, and other examples, suggest the need for ensuring that data and inputs provided to AI systems draw complete and correct images for the algorithms, proper oversight or a system of governance with distinctive stakeholders for AI initiatives, as well as the important matter of inserting controls in place for enforcements ("3 Essential Steps," n.d.). These and other considerations merit the case for the arguing of inclusion of AI governance (Lyons, 2017) in business management studies (BMS).

This chapter will critically analyze the why, what, and how of AI governance in management education with focus on developments in the United States and the United Kingdom. The "why" aspects seek to identify reasons as to why AI governance should be included in BMS. The "what" aspects would identify AI governance contents for inclusion in BMS. The "how" aspects would examine and propose how the AI governance contents could be delivered in BMS. The advanced economies of the United States and the United Kingdom are selected as case studies as both economies are among the leaders in AI applications (Hall, 2017). The two advanced economies are generally perceived as thought leaders for AI governance (Vincent, 2018) in view of their relative advanced legal and regulatory systems when it comes to policymaking and regulatory initiatives for new technologies.

This chapter will begin with exploratory discussions on what AI is all about and its main current applications so as to set the context. The section following this will examine the case for inclusion of AI governance in BMS, especially in the United States and the United Kingdom. This chapter will next explore the major features of AI governance for inclusion in BMS in these two respective economies. This will be followed by an exploration of how AI governance could be learned and taught in BMS in these said economies.

ARTIFICIAL INTELLIGENCE APPLICATIONS IN THE ECONOMY

Artificial Intelligence refers to the simulation of human intelligence processes by machines, and in particular computer systems (Rouse, 2018). Such processes include learning, meaning the access of information and the rules for applying them. It includes reasoning, or the use of the rules to reach conclusions; and self-correction or auto-responses to resolve problems identified. American computer scientist, John McCarthy, coined the discipline in 1956, but today AI is an umbrella term encompassing everything from robotic process automation to actual robotics (Rouse, 2018). Artificial Intelligence systems could be categorized as strong or weak (Majid al-Rifaie & Bishop, 2015). A strong AI system is an AI system with generalized human cognitive abilities having sufficient intelligence to solve unfamiliar tasks. It could on the other hand be classified as weak, or narrow AI that is designed and trained for specific routines.

Artificial Intelligence applications in play include expert systems, or knowledge-based systems (KBS) that need to have the capacity to explain their process of reasoning and conclusions to end users, ultimately contributing to higher quality decision-making reinforced by speed and accuracy (Mahomodi, Nejad, & Ershadi, 2014). There is also machine or computer vision that makes computers comprehend images and videos that lead to appropriate response actions as exemplified in the navigations of autonomous robots (Maskara, 2017). Then, there is speech recognition or speech to text. These cover the capturing and digitizing of sound waves, word formation from phonemes, and contextually analyzing the appropriate spelling of words sounding similar (Smadi, Issa, Trad, & Samdi, 2015). All of these and more (Hyde & Chow, 2019; Corea, 2018) have been successfully deployed and used for industrial, government, and consumer purposes for many years because powerful AI ideas are integrated into the human context of actual use and into the IT context of organizations (Smith & Eckroth, 2017, p. 7).

Artificial Intelligence consumer-dedicated applications space include Google's search engine, autonomous vehicles, Apple's Siri, Microsoft's Cortana and Bing, Amazon's Echo, Facebook's automatic photo tagging, Netflix's movie guide, and various automated financial services (Ohlhausen, 2019). Big business entities are now employing AI for market guidance, enhancing customer relations management, manpower deployment, risks management, and enterprise resource planning. Artificial Intelligence's ascendancy in the economy in part is attributed to the rapid rise of the use of big data from more efficient scale deployment of enormous varieties of data (Bean, 2018; Elish & Boyd, 2017; Hansen, 2017). This is because AI is very much better at identifying patterns than humans thereby enabling all kinds of profits and nonprofits to achieve more and better insights out of their data. Current and future trends in business intelligence, blockchain technology, document management improvements, real-time targeting, and edge computing are also said to be driving AI applications forward (Matthews, 2017). Artificial Intelligence and machine learning operating with networking analytics tools in particular perform faster and more accurately than operations professionals, and without the need for downtime (Mathias, 2018).

Statistical data on robotics shipments, AI startups, and patent counts, suggest increasing signs of a large surge in AI-related activities, and ergo huge impacts on the economy (Furman & Seamans, 2018). Artificial Intelligence systems are able to create value across the value chain in machine learning, natural language, and autonomous vehicles, and computer vision across retail, electric utilities, manufacturing, health care, and education. Investments in these domains approximated US$26 billion to US$39 billion for 2017 (Bughin et al., 2017). The accelerated pace with which AI is growing is further demonstrated by the envisaged growth of AI software shipments of some 50% annually. This is estimated to reach US$57.6 billion in 2021, up from US$12 billion in 2017 and US$8 billion in 2016 (Ghosh, Derg, Deo, & Fernandes, 2018). Artificial Intelligence and robotics may in general increase productivity growth potential, with some jobs and industries doing well, but others relatively less so (Hoban, 2018).

Artificial Intelligence development, however, is not positive all the time (West & Allen, 2018). It encounters numerous challenges as it evolves. Artificial Intelligence flourished from 1957 to 1974 with enhanced computational power to store more data. Information became faster, cheaper, and more accessible (Anyoha, 2017). Then AI faced the serious difficulties to exhibit intelligence because of the limits of computational power. Funding boosts in the 1980s together with an expansion of the algorithmic tool kit nevertheless reinvigorated AI. The fresh wave of engineers and data scientists in the 1990s and 2000s assisted further, despite the absence of state funding. The technological progress of AI laid the foundation for the defeat of grand chess master Gary Kasparov by IBM's Deep Blue in 1997, and Google's Alpha Go's defeat of Chinese Go champion Kie Je in 2018 (Shead, 2018). Such, and other even greater developments in AI deployments have and would become increasingly common in coming years. As they embed deeper into everyday applications, they raise questions as to how they could transform society, the economy, and even politics (West, 2018).

Artificial Intelligence is argued to have reached critical mass importance because of massive data growth, better algorithms, cloud technology, smart networks, and cyber insecurity insights (Lauterbach & Bonime-Blanc, 2016). In Europe, for example, the European Parliament (EP) commissioned a report to evaluate whether society should be apprehensive over a more automated world journey, and how society might be able to better understand a technology already shaping the world's future (Bentley, Brundage, Haggstrom, & Metzinger, 2018), but which is not without limitations. Artificial Intelligence's challenges and limitations in practice are generating a moving target issue for policymakers and business leaders (Chui, Manyika, & Miremadi, 2018).

These concerns concurrently raise important policy, regulatory, and governance issues. This chapter will analyze various AI governance challenges including ethics. Computational ethics is an emerging discipline that seeks to provide machines not merely with right and wrong choices, but also with acceptable behavioral parameters within society (Lauterbach & Bonime-Blanc, 2016). As successful applications of these principles and consensus around them are being forged, serious discussions focusing on both AI business opportunities and AI governance would continue to accelerate. These extend as to questions on why people, businesses, and the academic community could and should grapple with these matters (Whittaker et al., 2018). The next section would accordingly draw out important AI governance challenges from the perspectives of businesses and business education, and why they matter.

WHY ARTIFICIAL INTELLIGENCE GOVERNANCE MATTERS

Governance in both business and nonprofits focuses on performance and conformance. This means that those in charge would need to ensure that their entities perform according to internal and external expectations, while also conforming to internal and external rules or benchmarks taking into account the risks involved (Bridgman, 2007). Artificial Intelligence's potentials in the economy, while tremendous and surging are also accompanied by substantial risks extending from inequality, labor disruptions (Furman & Seamans, 2018), oligopolistic world market structures, entrenching totalitarianism, and various other forms of instability. These could pose various governance risks and challenges in business (BIC, 2017; Dafoe, 2018).

Risks arising from AI governance limitations abound. Amazon's recruiting tool for the hiring of software engineers in 2014 was swiftly tanked when the AI system began discriminating against women, while ProPublica's AI system used for predicting the probability of criminals reoffending in 2017 was put on hold when it acted with bias against blacks (Shaw, 2019). More interesting examples emerged in 2018 (Knight & Hao, 2018). These pertain to self-crashing autonomous cars occurring between 2017 and 2018 posing legal rather than technical considerations for commercial developers refusing to make their proprietary intellectual property protected code available for inspection; and Cambridge Analytica's exploitation of Facebook's data sharing practices that triggered an uproar in March 2018 about its impact on the outcome of the 2016 presidential election, Mark Zuckerberg, the CEO of Facebook responded by promising to use AI system to spot and block malicious contents. The global campaigns advocating for the ending of automated deadly drones also attracted media attention. This induced Google to abandon its Project Maven drone artillery initiative, with the global AI platform instead formulating an AI code of ethics. Other developers, not on the same track continue to put the agenda of algorithms for peace at risk. Also, as face recognition systems with high threats to privacy concerns grow, civil liberty groups are expressing concerns over their potential applications in vehicles and webcams. More troubling, especially for celebrities and senior politicians, is the use of generative adversarial networks (GANs). These comprise two dueling neural networks with the capacity to conjure extremely realistic, but completely made-up images and videos. These are being increasingly abusively deployed to construct false clips using AI thereby putting the reputations of business and individuals at risk.

Artificial Intelligence systems now, and more so in the immediate future, will acquire enhanced power to generate life-changing everyday decisions about business, people, and so on. These would raise troubling governance issues as they could reinforce insights from real-world information, and amplify for instance, discriminatory risks like racial and gender bias, and others as alluded to above (Shaw, 2019). Artificial Intelligence governance is argued to be the notion that there should be a framework to ensure that AI technologies are well undertaken and developed with the aim of helping society to navigate the deployments of AI fairly, ethically, and safely (Rouse, 2018). As AI deals and relies hugely on data, AI governance grapples with issues like the right to be informed and its potential breach. Through its primary focus on autonomy, data quality, and justice, AI governance seeks to bridge the gap currently existing between accountability and ethics and technological advancement.

Artificial Intelligence's particular challenges and complexities when deployed at scale within fundamental societal structures, necessitates measured oversight at scale. This is because AI systems do not adjust neatly into existing governance framework. Apart from difficult technological issues, AI governance would have to deal with various conceptual policy matters like AI definitions, ethical standards and norms, accountability, or degree of oversight. It would also need to grapple with matters pertaining to measurement and evaluation, controls, openness, privacy and security, risks of AI-biased solutions, institutional oversight competences, and political agendas. The United States (Bollier, 2018; Kratsios, Cordova, & Walker, 2018) and the United Kingdom (Edmonds, 2017; House of Lords, 2018) are amongst those at the forefront of dealing with such AI governance issues, but even they are at early stages. Though much of the thinking on these matters are positive and well-intended, policy postures especially those from the United States are very preliminary and largely tentative. In contrast, those for the United Kingdom are relatively more comprehensive with targeted policies to invest in STEM education, boosting of public and private research and development, and leading the global initiatives on AI governance (Clark, 2018).

To address these governance and ethical matters, an AI governance framework for business such as depicted below has been proposed (Gagne, 2018). The operations process perspective framework suggests that the main governance challenges of performance, security, and privacy are impacted by both watching and coaching human-driven activities as well as by AI-driven collaborating and autonomous activities (Gagne, 2018). Performance refers to the ability of AI systems to perform predictably and accurately so as to gain trust in the outcomes delivered. To ensure performance, AI systems have to secure its processes, data, and outcomes and not be compromised for example by unexpected patterns and adversarial data. In turn, privacy needs to be ensured when data is injected by users as well as data generated by them as they interact with the AI system.

Figure 5.1 suggests that largely human-driven processes of watching and coaching could be powerfully enhanced by AI systems that provide quick statistical inferences (Gagne, 2018). At higher levels of autonomy where AI systems are collaborating with humans they tend to perform substantial parts of the process such as in the processing of insurance claims. But, fully autonomous AI systems, by contrast, make most decisions on their own at speeds beyond detailed human oversights such as in robo-driven wealth management activities. These levels of autonomy would vary within and across industries. These also suggest that businesses would need to reflect their own general principles for each of these considerations, and employ them individually to their AI systems so as to formulate particular rules for given scenarios. These could concern things like the roles of the AI systems, deployment requirements, risks monitoring, boundaries for adversarial governance models, and in particular how these could link with wider existing corporate governance surrounding particularly data and ethics (Gagne, 2018).

	Level of Autonomy			
	Human-Driven		**AI-Driven**	
Performance Accuracy Bias Completeness	*Watching*	*Coaching*	*Collaborating*	*Autonomous*
Security Adaptability Adversarial robustness	*Watching*	*Coaching*	*Collaborating*	*Autonomous*
Privacy IP Capture Impacted users	*Watching*	*Coaching*	*Collaborating*	*Autonomous*

Figure 5.1 AI governance framework.

Good AI governance rests on accountability, or the need to explain and justify decisions. They also rest on responsibility, or the role of personnel themselves and the capability of AI systems to answer for their decisions and identify unexpected outcomes; and thirdly on transparency, or the necessity to monitor and regenerate the mechanisms by which AI systems makes decisions and adapt to the environments as well as to the governance of the data used (Dignum, 2018). These imply that to ensure accountability, decisions have to be derivable from and explained by the decision-making algorithms employed that in turn incorporate the moral values and societal norms they used for the deliberations. Further, as responsibility metamorphosed, mechanisms are also needed to connect the AI system's decisions to the fair use of data. All of these in turn would also depend on activity nature and autonomy levels. This would further suggest that AI governance could hinge on rules or regulations to monitor robustness and reliability so as to be able to explain decisions and calibrate biases to incorporate ethical principles and address societal concerns.

Artificial Intelligence governance concerns, as alluded to earlier, are complex (Whittaker et al., 2018). To provide clarity, technologists and researchers have separated these into immediate or near term and longer-term concerns (Cave & Oheigeartaigh, 2019). Near term concerns would involve fairly clear participants and parameters like accountability, privacy, algorithmic bias, and systems safety. Algorithmic accountability needs various controls to ensure that the AI system could verify that it acts in line with intentions and avoids exacerbating existing biases and inequalities including negative outcomes for privacy safeguards and safety concerns (New & Castro, 2018). Longer-term concerns relate to those that are less certain like technological unemployment or wide-scale loss of jobs arising from massive AI deployments, manipulations, public good, risks of AI assuming wide superhuman capabilities beyond control, and pivotal questions about humanity's place in the intelligent machine era (BIC, 2017). Long-term concerns thus pertain to superintelligence, consciousness, and personhood.

Researchers working on near term issues perceive longer term concerns as distractions from real and pressing challenges or as too speculative for productive response, while those taking the longer-term orientation claim that their potential impacts are miniscule compared to those of current-day systems and ergo merits proportionate share of research focus. Arguments are now raised, that in reality, there are many linkages between near and long-term concerns. Those with long-term orientation could look to near term concerns and practices as the latter could impact materially longer term outcomes; while simultaneously those with near term orientation could gain from insights of long-term forecasting and contingency planning (Cave & Oheigeartaigh, 2019). Hence, near term governance concerns like robustness and reliability could quickly grow into importance leading to linked research priorities for both near and longer terms. Policy directions formulated now could secondly impact AI systems in manners highly pertinent to longer term concerns. For instance, where policy directions make explainability a requirement, funding would lean towards developing transparent systems; while powerful but opaque systems could be deprioritized. Further, and thirdly, precedents and collaborations instituted now such as for AI in financial services could generate longer term benefits.

While some of these alluded to AI, near- and longer-term concerns are encountered by other technologies too, others are genuinely new arising from AI systems' increasing autonomy or the capacity to make decisions by itself. It includes the intelligence or the ability to make human-level or better-than-human decisions on matters of growing complexity. As such, AI governance is necessary to develop public confidence in AI (Cave, 2018; Cave, 2016).

Both near and longer-term AI governance concerns are shaped by responsible business innovations. A good case example is provided by a powerful global tech company when it announced that its AI system was designed to assist humanity. It further claimed that this was because its AI system was transparent, maximized efficiencies without compromising people's dignity, addressed privacy concerns, had algorithmic accountability empowering humans to undo unintended harm, and have safeguards against bias (Clinch & Turak, 2018; Vanian, 2018). Biases in AI are increasingly recognized as challenges awaiting resolutions largely because of the shortcomings of algorithmic decision-making. The technical research on bias in machine learning and AI algorithms are also still in its infancy, especially in the digitization era (Van Otterlo, 2018). Issues of bias and systemic errors now mostly addressed by algorithm designers and data scientists with relatively less exposure to social or public policy considerations are particularly in need of some attention from more diverse cohorts of professionals so as to benefit from their inputs (Osoba & Welser IV, 2017). The path to remedy algorithmic bias should further be tempered with a healthy dose of regulatory restraint (New & Castro, 2018).

Like most tech innovations with cross-border impacts, AI governance depends on forward-looking policies and regulations and responsible business innovations as alluded to earlier. In particular, it is difficult for AI and other technologies to be widely and effectively diffused globally without some kind of international AI standards (Erdelyi & Goldsmith, 2018; Medhora, 2018). As attentions and actions gravitate towards various AI governance concerns highlighted here, this would merit the case for a stewardship body (BIC, 2017) that would oversee AI and data governance issues to ensure that the new technologies' benefit the wider public, not just the privileged, and their risks concurrently mitigated.

In response, multiple progress has been made in the development of professional and legal ethical codes to govern the design and application of AI technologies. But, in view of rapid distributed and often proprietary AI development and implementation, these forms of soft governance encounter formidable challenges. These include the problems of coordination among different ethical codes together with issues around enforcement mechanisms that would go beyond voluntary cooperation by stakeholders working in government, industry, and the academic community. There are good merits for new ethical frameworks for AI to move beyond individual responsibility to hold powerful industrial, governmental, and military interests accountable as they design and apply AI (Campolo, Sanfilippo, Whitaker, & Crawford, 2017). This could further lead to the development of an international AI regulatory agency drawing on interdisciplinary expertise to create a unified framework for the regulation of AI technologies and inform the development of AI policies around the world. Importantly, this could avoid the development of nationally fragmented AI policies that could lead to international tensions (Erdelyi & Goldsmith, 2018).

The general tilting towards AI regulations has been attributed to the opaqueness of AI systems that contributed to massive information asymmetries between developers of these systems, consumers, and policymakers (Gasser & Virgillio, 2018). In the United States and in the EU, people generally desire AI to be regulated as there appeared to be no consensus that AI applications are always good, but on the other hand they do not generally trust anyone to do that (Zhang & Dafoe, 2019). Their foremost AI governance concerns are for the need to deter AI-supported surveillance from violating privacy and liberties, from being deployed for the dissemination of fake and harmful content online, and from the generation of harmful cyber effects on individuals, businesses, and governments (Zhang & Dafoes, 2019). In relation to AI governance issues, the public appear to have the most trust in university researchers, followed by the military, and science-technology base entities.

From the regulatory perspective, a layered framework has also been proposed to deal with the complex nature of AI governance. This comprised a social and legal layer of norms, regulations, and legislations; an ethical layer of criteria and principles; and the technical foundations layer of data governance, algorithmic accountability and standards that support both the ethical and social layers (Gasser & Virgilio, 2017). The instruments mapped onto these three layers could be developed at different times. For example, in the near term, governance proposals could focus on developing standards and principles for AI algorithms, while for the mid- and long-term, national economies could work on specific legislations to regulate mature AI applications. This framework further demonstrated how principles, policies, norms, and laws could be merged and work together within and across the other layers. It also dealt with information asymmetries, besides suggesting the insertion of instruments to enhance understanding of AI in different contexts of applications (Gasser & Virgillio, 2017).

Pushing deeper, a tort-based approach requiring AI developers, marketers, and manufacturers to adhere to safety and legal standards with oversights by an independent AI agency has been proposed. This framework draws on the institutional strengths of legislatures, agencies, and the judicial system. Importantly, it offers a flexible regulatory approach for oversight minus draconian rules, while giving developers incentives to cover safety features and discouraging marketers from distributing uncertified AI system that do not cover public safety standards (Scherer, 2016). Thus, AI governance viewed on a broad basis would have to grapple with policy, regulatory, and ethical issues (House of Lords [HL], 2018; Mahroum, 2018; Stanford University, 2016; West & Allen, 2018).

Regulatory concerns aside, an equally important pertinent policy consideration pertains to the impact of AI on teaching and learning in higher education. AI software based on complex algorithms designed by programmers capable of transmitting their own bias or agendas in operating systems are gradually replacing many sets of tasks at the core of teaching practices in higher education (Popenici & Kerr, 2017). This kind of risk, privacy issues, quasi-monopoly of a few tech giants, and various other ethical matters, are the kind of domains governance deals with. Artificial Intelligence governance as discussed here ergo merits consideration as an area of study in higher education and in particular in business management education. In particular, BMS in higher education need to address AI governance matters like justice and fairness, bias, ethics, infrastructural thinking, deeper interdisciplinarity, and so on (Whittaker et al, 2018).

ARTIFICIAL INTELLIGENCE GOVERNANCE TEACHING AND LEARNING IN BUSINESS MANAGEMENT EDUCATION

In AI-based systems, their continuing development and applications leave largely unanswered a wide range of important short and long-term questions related to the social impacts, governance and ethical implementations of these technologies and practices. Various higher education institutions (HEIs) in response are gathering evidence-based research to provide guidance to decision-makers in the public and private sectors (Berkman Klein Center [BKC], 2018; Future of Humanity Institute [FHI], 2018). They are also engaging in impact-oriented pilot projects to enhance the applications of AI for the public good, besides accumulating institutional knowledge premised on the ethics and governance of AI, as well as enhancing interactions with the business ecosystem and policymakers. Industry, especially those to do with computer technology is also increasingly focusing on AI governance to ensure their safer deployments (Internet Society, 2017). Governments on their part also equally recognized the crucial importance of AI governance in the economy (Executive Office of President [EOP], 2016). This is an important illustration of positive Triple Helix or collaborations between business, the academia, and governments in higher education (Santonen, Kaivo-Oja, & Suomala, 2014).

Universities, largely the most trusted by the public as alluded to earlier, could help shape the direction of AI governance thinking and practices in several ways (Gasser & Virgílio Almeida, 2017). Foremost, in alignment with their core missions, universities could supply open resources for the research, development, and deployment of AI systems, especially for the social good and for making their involvements and participations in AI more explicit (Brockman & Sutskever, 2015; Dadich, 2016; Etzioni & Etzioni, 2016). Universities when advancing the agenda of accountability and access could further step up as independent and public-interest-oriented institutions with the competency of measuring and evaluating AI systems' accuracy and fairness. Users, for example, might not fully grasp matters behind the news feeds on social networking sites, or what personalized assistants are really doing. Universities being the trusted stakeholder (Beck, 2018; Thelisson, 2017) could unravel the opaqueness of the algorithms involved to provide clarity for these (Coiffait, 2018), as well as responding to adverse algorithmic judgments coming out of AI decision-making systems that are not in sync with the community's values (Etzioni & Etzioni, 2016). These would include the undertaking of impact evaluations that incorporate social and economic analysis (Mckenzie, 2018; Reisman, Schultz, Crawford, & Whitaker, 2018) that could provide evidentiary support for policy-making now increasingly observed in the United States and the UK (Kushner, 2016; Selinger, 2018).

Operating as conveners in the AI governance ecosystem, universities could also bring together the various stakeholders to enhance inclusion (Daugherty, Hintermann, Morvan, & Vzirani, 2017; Jacquet, 2017). Inclusion labs such as found in the United States and the United Kingdom to bridge the accessibility gaps between the underserved and the more privileged are fine demonstrations of these (AI Now Institute, 2017; Epstein et al., 2018). A good recent example of what could be done is The Ethics and Governance of Artificial Intelligence US$27 Million Fund. This is spearheaded by the Knight Foundation in the United States to apply the humanities, the social sciences, and other disciplines to the development of AI at the MIT Media Lab and the Berkman Klein Center for Internet and Society at Harvard University.

Universities endowed by their experimentations and creativity strengths are suitably placed to integrate the principles of ethics, design, and engineering for the continuing rationale development of AI governance for policymaking and regulatory initiatives (Madore, Jing, & Schacter, 2016). Business management schools in particular have continued to surge ahead in terms of research and other related activities in this domain. They have also paid particular attention to the impact of new technologies such as AI and robotics on the economy, businesses, and in tertiary-level education in management and related studies (De Buchet, 2018). As such, business management schools are well-positioned to serve as anchors to the AI governance learning cluster. They, however, need to be supported by other disciplines like computer science, engineering, law, psychology, and other pertinent representations from the social sciences and the humanities. This would help to ensure the deployment of a multidisciplinary approach considered essential when addressing AI governance issues (Cath, Mittelstack, Wachter, & Taddeo, 2018).

WHAT TO INCLUDE FOR LEARNING AND RESEARCH IN ARTIFICIAL INTELLIGENCE GOVERNANCE

Concerns over the capabilities and challenges of AI systems are growing. These were fleshed out by the recent Stanford University (2016) study. The process of designing feasible governance systems for AI, autonomous systems, and algorithms are, however, complex and still evolving. Some guidance, nonetheless could be drawn from the development and evolution of governance structures going on in the Internet environment. Beyond these, are the larger structural challenges relating to future governance practices that suggest a direction away from simple static-centric, command-and-control regulatory schemes toward more complex approaches to governance.

A common feature across many of these models is the notion of modularity embodied in the form of layered governance that combined different instruments for grappling with and addressing the earlier alluded to issues (Gasser & Virgilio, 2018). Modularity seeks to cut down the number of interdependencies that must be analyzed through the identification of highly interdependent tasks and those that are not. This would make it a shared responsibility among all stakeholders in the AI ecosystem. Such emerging models have to be situated in and interact with existing institutional frameworks of applicable laws and policies especially on human rights matters. This is demonstrated in the three-layered AI governance framework discussed earlier; meaning the technology, ethics, and social and legal layers (Gasser & Virgilio, 2018). The curriculum for a typical AI governance study could ergo be guided by covering matters relating to these three layers. Regardless of whether they are physical systems, software systems or intelligent personal assistants, all AI systems and autonomous systems rely on data and algorithms. This topmost technical layer has to reflect accountability, accuracy, auditability, and fairness principles.

Pertaining to the technical layer again, much of today's AI, especially in the public sphere, has come to be known as machine learning (ML) that blends ideas to design algorithms that process data, make predictions, and help make decisions (Jordan, 2018). Machine Learning algorithm experts have now begun cooperating with database and distribution experts to develop scalable robust ML systems that reflected the larger social and environmental scopes of the consequential systems. This fusion of ideas and technology trends has been tagged as AI that now warranted closer scrutiny. Arguably, much of AI development has not come from the pursuit of human-imitative AI alone as generally perceived, but also from major complementary initiatives like intelligence augmentation (IA) and intelligent infrastructure (II; Jordan, 2018). Intelligence augmentation is where computation and data are applied to create services that augment human intelligence and creativity. Intelligence infrastructure is a web of computation, data, and physical entities that makes human environments more supportive and safe. These developments suggest that the need to go beyond the narrow subset of industry and the narrow subset of academia with risks blinding humanity to the full scope of AI, IA, and II.

Perching on the technical layer is the ethical layer (DeBaets, 2015). Research has explored the potential risks of AI (Bostrom, 2013; Yudkowsky, 2008), and connected ethical issues (Beauchamp & Chilress, 2001; Bostrom & Yudkowsky, 2014; Kamm, 2007; Wallach, 2008). Ethical challenges might arise as AI applications could be narrow, wide, or superhuman (Kelly, 2017). These could currently appear visionary, but it seemed predictable that society would encounter them and would as such need to research in this direction (Bostrom & Yudkowsky, 2014). However, for now, the ethics in AI could be dealt with through the ethical AI norms and principles provided by the Institute of Electrical and Electronic Engineers (IEEE, 2018). These, when appropriately applied, would allow actions driven by algorithms to be evaluated against ethical criteria and principles.

Meanwhile, as AI began to impact daily living in many significant ways (Stanford, 2016); the development of ethics, standards, and regulatory considerations for AI is fast emerging as important considerations. This third social and legal layer could address the process of creating institutions and allocating responsibilities for regulating AI and autonomous systems. Technology companies have already begun framing voluntary self-regulation, as exemplified by "The Partnership on Artificial Intelligence to Benefit People and Society" and "The Ethics and Governance of AI Fund" in the United States (Yapo & Weiss, 2018). Concerns have been growing about the intentional and unintentional negative consequences of AI systems (Amodei et al., 2016). It remained to be seen whether and to what extent regulations would emerge in response. This could probably cover what AI systems have to offer, while holding them accountable through, for example, the legal right to explanation from them (Doshi-Velez & Kortz, 2017).

Legalistic and technological approaches have emerged to assist decision-makers when needing to examine the laws and regulations of AI systems (Petit, 2017). The legalistic approach could commence by listing legal issues impacted by AI systems; like liability, privacy, cyber security, and so on. The technological approach envisioned legal issues from the bottom-up standpoint of each kind of technological application like social robots, driverless cars, and so forth. An often-mentioned third approach distinguished between AI ethics and AI law (Palmerini et al., 2016). Artificial Intelligence ethics insists on norms that could be directly incorporated into technology in a sense that a command and the compliance to it are imbued in the technology itself. Artificial Intelligence laws on the other hand focused on external norms that govern the operation of AI system once introduced in society. Both soft and hard legal mechanisms could thus be deployed to reduce the public risks that AI presented without stifling innovation (Thierer, O'Sullivan, & Russel, 2017).

With respect to AI policymaking, the state could explore and compare the merits and limitations of interventionist approaches that banned the production of uncertified AI systems; less interventionist approaches involving for example a government entity devoted to subsidizing AI safety research combined with strong tort rules that penalize AI developers who ignore the results of that safety research; or, something in-between like empowering a policymaking entity to define AI, generate exceptions that would allow AI research to be undertaken in particular environments without researchers being subjected to strict liability. This would by extension imply that, unless a robust case could establish that a new invention would bring serious harm to society (Bentley et al., 2018), the innovation should be allowed to flourish, and that if problems developed, this could be subsequently dealt with quickly (Thierer et al., 2017).

In brief, this three-layer modular framework as elaborated, offered an avenue for reflecting about AI governance targeting at the definition of appropriate behavior for AI and autonomous systems. Insights and doubts raised from the alluded to three-layered AI governance framework could provide a suitable menu for developing a basic AI governance curriculum at tertiary levels. This could involve the incorporation of AI in the practice of corporate governance and strategy formulation and execution. This is not just about the matter of automating leadership and governance, but rather augmenting board intelligence using AI. Just like how enterprise resource planning (ERP) enhanced business competitiveness in the information era, AI systems could similarly be deployed for both strategic and operating decision-making (Libert, Beck, & Bonchek, 2017).

Where notion of governance in the economy is concerned, business management schools are most involved, especially after the 2008 global financial crisis. As such, it is well-placed to host the learning and research of AI governance. But, it would be better for the business school to cohost this with the computer science, engineering, law, humanities, psychology, and social sciences faculties to give the course a multidisciplinary orientation. It should also be offered as a final year undergraduate elective open to all students in the university. At some stage in the future, when more is known and achieved in AI governance learning and research, the options to upgrade this to higher and wider levels could then be explored.

DELIVERING THE AI GOVERNANCE ELECTIVE

Drawing from the insights, controversies, and doubts generated by the three-layered AI governance framework, the AI governance curriculum could be designed as an elective for final year undergraduates of all disciplines. It could comprise and cover AI technology (Singapore Management University [SMU], 2018); AI ethics (The University of Edinburgh [TUE], 2018); and AI public policy (Tuomi, 2018; University of Otago, 2019). This learning approach seeks to match the learning preferences of present day millennials brought up in the digital environment (Magnacca, 2018; Yeoh, 2010). In this respect, active learning instructional strategies have been used to generate excitement and enhance learning and generally found to generate positive outcomes (Freeman et al., 2014). Active learning interventions could include group problem-solving or the use of personal response systems. Increasingly, this also relied on blended learning (Parrot & Jones, 2018) that embraced the benefits of both traditional teaching in the classroom and IT supported learning. Together they offer the scope for collaborative learning, constructive learning, and computer assisted learning (Lalima & Dangwal, 2017).

Learning facilitators could also explore using the Harvard University Socratic case method (Kimball, 2006; Yin, 2005), problem-based learning (PBL), or project-based learning (PJBL) depending on students' learning styles (Alves, Ribeiro, & Machadol, 2018; Singh, Kundur, & Nguy, 2018). Project-based learning is predominantly task-oriented with activity supervised by the tutor; whereas in PBL, the problems are provided by the staff, but with students defining what and how they wished to learn (Campbell, 2014). Both Harvard's case method and the PBL and PJBL case studies have their followings depending on the contexts of the learning ecosystem. These and blended learning support the widely used Bloom's learning framework (Adesoji, 2018).

Meanwhile, AI governance teaching in the United States other than those available at Harvard University alluded to earlier is in general undertaken as part of AI general courses or as part of AI ethics standalone courses. The MIT Media Law researched and taught AI ethics and governance through a US$27 million initiative in collaboration with the Berkman Klein Center for Internet and Society at Harvard University (MIT Media Lab, 2017). This project addressed AI's global challenges from a multidisciplinary perspective (Coldeway, 2017). Recent AI public policy hearings have also called for policies to maintain the country's AI leadership including policies to recruit top global talents to U.S. universities (Felten, 2017).

The situation is broadly similar in the United Kingdom as elite Oxbridge; campuses also mainly drive the direction of AI research and education in the country. Cambridge University has the Leverhulme Centre for the Future of Intelligence and the Centre for the Study of Existential Risk. It is also one of the founding partners of the Alan Turing Institute based in London. There is also the Future of Humanity Institute (FHI) that housed Strategic AI Research (FHI, 2018) at Oxford University. Other U.K. universities with strong teaching and research interest in AI in the United Kingdom included Bath University and the University of Edinburgh (Bryson, 2018).

CONCLUDING REMARKS

This chapter supports the case for the teaching and research of AI governance in business schools in the United States and the United Kingdom. Artificial Intelligence governance insights are fast becoming necessary given the many tough complex questions that AI deployment have generated especially on the political, social, and ethical fronts. Business schools being increasingly tasked to grapple with governance and ethical issues are indeed appropriately suited for this role. But, they need to do this jointly with other academic disciplines, as AI designs and deployment issues are hugely complex. Joint collaborations from different fields of expertise and knowledge have a better chance for the germination of well-thought-out quality AI governance solutions. In this connection, and armed with better resources, the elite universities in both the United States and the United Kingdom have shown exemplary leadership. The smaller and less prominent universities must also play their roles. The resource limitations issue faced by them could be addressed through partnership networks along the lines of the principles and practices of the sharing economy framework. The inclusive approach would enable the world to tackle in robust fashion the many complex challenges posed by AI governance issues.

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CHAPTER 6

ROBOTS AND ARTIFICIAL INTELLIGENCE AS WAYS TO INTEGRATE EDUCATION AND WORK LIFE

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In educating students for work and a career in the health and well-being sector, the traditional strategy has been "learning by rote"; that is, that educators have students read textbooks and listen to the educator talk at a podium in a lecture room. Sometimes, to buttress the reading and listening, students are put to work on exercises that illustrate the learnings in the books and lectures. Yet, challenging this traditional model for some time now, is what the

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Nobel Laureate Herbert Simon (1996) has called "learning by doing"; that is, learning in ways that are much like the work life for which the students are being educated. To explore and help specify in what ways, how, why, and for whom the model of learning by doing appears most promising, we report in this chapter on our learnings as educators as part of a research project called *ROSE*, an acronym for *Robots and the Future of Welfare Services* (ROSE, 2018). As part of ROSE, we began with students co-creating with service staff at a senior citizens' group home services to be delivered by a social robot to these senior citizens (Ainamo, Lehto, & Porokuokka, 2018).

ROBOTS AND THE FUTURE OF WELFARE SERVICES (ROSE) PROJECT

As many treatises in literature on topics such as "cobots" or collaborative robots (Colgate, Wannasuphoprasit, & Peshkin, 1996) and "IoT" or Internet of Things (Chen & Hu, 2013) attest, there are currently two parallel revolutions taking place in postindustrial societies: (a) an enormous growth of demand in welfare and health services because of aging populations, and (b) an emergence of a new generation of cognitive robots. The current state of the art in this situation includes developments such as an introduction of service delivery by robot, something that is by many taken to hold great potential for increasing the productivity of healthcare and welfare service provision (Sparrow & Sparrow, 2006). The hope is that service robots will over time improve the quality of services that will continue to be offered, as well as lead to totally new models of service delivery, even to new revenue and business models (ROSE, 2018).

Robots and the Future of Welfare Services—"ROSE" for short—is an Academy of Finland strategic research project funded from the Prime Minister's office of the Republic of Finland (ROSE, 2018; cf. Ventä et al. 2018). Running from 2016 to 2020, the mission in the ROSE project is to conduct research on how the advances in service robot technologies in terms of welfare and logistics enable the creation of innovative new products and services for the renewal and improvement upon how the healthcare sector Finland works, given the country's aging population.

Framed in the foregoing way, ROSE follows, even leads, international research directions whereby the design process of new science-and-technology-enabled services coevolves with such dynamic phenomena as state-of-the-art technology and service ecosystems, without forgetting the psychological or social needs of individual users. Going after this bold set of goals involves answering research questions such as how robotics can assist in the reinvention or remodeling of healthcare and welfare services; and how such activities ought to be organized. On this mission, finding answers to the above kinds of questions, the hope is to work towards ways to utilize robots in a fashion that will be reasonable and effective from the perspective of all: members of the aging population, their next of kin and their caregivers, care professionals, robotics and health-technology companies, as well as the funders and organizers of healthcare and welfare services in and across the public and private sectors.

Aging populations in many other countries than Finland also suffer from limited resources, and growing and already high levels of spending on elderly care. Thus, Finland is not alone in calls for higher productivity through, for example, robots replacing human labor. The content of work, methods, and roles of the service staff are in flux in healthcare and well-being services in not only Finland but also, in the rest of Europe and in Japan. Many believe that new technological solutions and the possibilities of robotics will require new kinds of expertise from future care professionals, new approaches to curricula development, and “deep learning” from their educators (Kim, Nan, Ha, Heo, & Zhang, 2015; Lecun, Bengio & Hinto, 2015; Niiniluoto, 2019), maybe even radically new models of learning.

All authors of this chapter were, at the time when the data for this chapter was collected, working at Laurea University of Applied Sciences, one of the partner institutions of higher education and research in ROSE. In the overall ROSE project, our specific task at Laurea was “action research” (Reason & Bradbury, 2008) and to organize a “living lab” (Schuurman, Marez, & Ballon, 2016) at an assisted senior citizens’ home in Sipoo Finland, a stone’s throw away from the outskirts of Helsinki. In this living lab, the idea was to have social robots functioning side by side with and complementing professional caregivers. These professional caregivers—nurses, a physiotherapist, and a manager—simply did not have sufficient time for social interaction with the senior citizens that they cared for. The view of robots within this context was complementary, rather than competitive in any way to human labor, in line with Laurea’s “together we are stronger” philosophy.

Our research questions in ROSE at Laurea, formally stated, were: (a) “What were the expectations of nurses and other staff at the senior citizens’ home in Sipoo in relation to a service robot?”; (b) “What kind of tasks did they think a service robot could take up within the context of welfare services for the inhabitants in that group home?”; and (c) “How did service delivery by robot maybe incur change in a care professional’s role or competence requirements?” We operationalized going after answers to these research questions following a “living lab” approach (Leminen, 2015; Pierson & Lievens, 2005).

To answer the above questions, the data was collected in two main phases. First, Paula and Jaakko, the second and third authors of this chapter, made seven individual interviews to initiate data collection and to grasp meanings that home care workers and elderly people associated to initiatives of applying robots in elderly care. In focus-group discussions with the nurses, physiotherapist, and manager, Paula and Jaakko mapped perceptions about home care and a priori perceptions of robots The data thus co-created was analyzed by them (and later, by all of us authors) through inductive content analysis. Yet, Paula and Jaakko did not do all of this work alone: They involved students.

They organized as an intensive study course for master's-level students across specialties of health and well-being (students of nursing, social work, and health economy, to be more precise) in tandem with the ROSE academic research project. The students participated in many important ways in planning, implementing the data collection for ROSE. They made new interviews in the real live home environment of the elderly people in order to grasp meanings related to how a robot could legitimately become a part of an elderly person's ordinary day, his or her human-individual's personal situation, or both. Thus, the students were very much engaged with what kind of robots would ultimately be appropriate and suitable for this particular senior citizens' home.

A LIVING LAB ON SOCIAL ROBOTICS AND NEW WAYS OF WORK

In a living lab approach, data is gathered using a versatile set of methods, including scenario building, individual and group interviews, observational studies, questionnaires, participatory observation, panel discussions, and workshops. Diverse sets of stakeholders are invited to participate in the various phases of the study, in the presentation of results and also in the assessment of the study (Dell'Era & Landoni, 2014; Hossain, Leminen, & Westerlund, 2019; Leminen, Westerlund, & Nyström, 2014).[1]

The living lab we organized involved placing social robot in the group home of eight senior citizens for 5 weeks. This was at *Elsie*, a service center for elderly people in Sipoo, a small community in the southern part of Finland, just outside Helsinki. The senior citizens' home was for eight senior citizens.

The way we set out to design and set up our living lab was by exploring interactions between elderly people and their care providers. Dialogue and evaluative discussions with professionals in/around decision health and well-being services, as well as with the users of such services, worked towards co-creation and the development of robot-delivered services while at the same time working towards systemic-level transformation. The students, we, the service staff, and the senior citizens worked towards outcomes that we could not, and tried not to, predetermine.

We thus had in our living lab experts across more than one lifeworld, across more than one generation, across a robot and more than one sort of a service user, across a physical site and a virtual one, and across more than one platform for change and improvement (Moore, Crozier, & Kite, 2012) to solve pressing real-life problems and to find out new practical solutions on how to deal with them. The students operated in this virtual-physical working environment in the spirit of open innovation. Paula and Jaakko, and later also Antti, the first author of this chapter, gave them room for ideation and participation. We provided all of the human participants experiences on which to reflect upon, chances for them and us to learn and to reframe our outlooks of work, research, education, and other facets of life.

In this living-lab approach of ours, we placed our students at the frontline of this interaction, and gave the students freedom to focus as they saw fit on the perceptions and expectations of professional caregivers. The students more or less self-organized themselves for "flipped learning" and various sorts of "learning by making" (Brown-Martin, 2018; Pilloton, 2018). The students self-organized themselves to focus on facilitation and finding out to what extent social robots could be of service in catering for such desires and preferences. The students organized in Sipoo at the group home focus groups for both the senior citizens and the care professionals.

STUDENTS' INTERACTION WITH SERVICE STAFF

As noted before, central among the service staff in our senior citizens' home were nurses, a physiotherapist, and the manager of the senior citizens' group home. Peripherally, also professionals and governors representing the Sipoo municipality and nongovermental organizations were involved in our project, but the latter would not in any way come into focus until much later. That is, the research design was so that members of the municipality and nongovernmental organizations did not take part in tye student-run focus groups.

The students soon found that everybody among the nurses, the physiotherapist, and the manager agreed that they as service staff lacked time and resources to cater to anything but the basic physical needs of these senior citizens, and thus lacked time to cater to the psychological and social desires and preferences of the elderly-home's inhabitants. The focus groups then oriented themselves towards co-creation of new and fresh ideas on employment of robots and artificial intelligence (AI) with and for the elderly, to propose new robot-enabled home-care services for elderly people.

The senior citizens in the focus groups and in the ROSE project as a whole had the role of being users of prototype solutions for everyday life problems that we were working on during and after the focus groups. In turn, the role of the robot, the type and model of which we had not as of yet chosen, was to be a boundary object and to thus enable competence development in using health technology with the goal of adding positive attitudes towards health technology.

The students thus immersed themselves intensively in care for the elderly, directly, without a robot-in-between. It soon became clear that the students differed from the nurses in that they came from the outside and could see the group home with fresh eyes; to co-create among themselves and with Paula and Jaakko new ideas on how to apply robots with and for the elderly (Ainamo, Lehto & Porokuokka, 2018).

In the focus group, the role of the students became emergently more than simple facilitation. It became their role to be the ones to reinvent home care in a senior citizens' home. The students focused their facilitation towards what could a social and service robot deliver as entertainment services and as psychological and social activation for the eight inhabitants in this group home (Lehto, Amino, & Porokuokka, 2018). The students proved to be able facilitators not only in the focus groups involving members of the service staff but also with the eight senior citizens who were the inhabitants of that home; each of the inhabitants had his or her own room in the group home.

The role of Paula and Jaakko was to collect data from the participants in the two focus groups (both with $n = 7$), to analyze the data, employing methods of inductive content analysis for this purpose.

DEMOS OF SEVERAL ROBOTS AND CO-CREATION FOR SOFTBANK'S PEPPER, A SOCIAL ROBOT

After the students had developed for all an understanding of the pertinent context through focus groups, they and Jaakko and Paula, together, demoed and tested both to the service staff and the senior citizens more than one make and model of robot: Nao and Pepper, both complex humanoid robots by Softbank, as well as Double 2 Telepresence Robot for iPad Tablet, a materially simple robot that was essentially an iPad tablet on a stick and wheels, by Double Robotics.

The rationale for these demos was to showcase what kind of services at this stage of technological evolution, from the perspective of "under the hood" of the robot, were possible. On the basis of what all learned in the focus groups and demos, Paula and Jaakko found that the kind of social robot that was most positively encountered was not too mechatronic or too serious but one that was "humanoid" or resembled a human and appeared friendly. While AI as a rule is approaching passing the Turing Test,[2] the emerging fact appears to be that a humanoid robot is more fun than something that may barely pass for a boring human being (Chan, 2017).

On the basis of these user experiences and biases, Jaakko and Paula chose Pepper, the social robot designed and marketed by Softbank. This choice was based on the discovery that the most fun robot is one that is not too large and not too small, a size that in practice is about the size of a 9- or 10-year old child. Again, Jaakko and Paula involved students in inquiring from the professionals what kind of services a hardware-and-software social robot of this kind could perform and deliver as well-being services for senior citizens.

Paula and Jaakko told the students that we were most interested in the context of these focus groups in service ideas that the focus-group participants could ideate and propose. Then and later, we were interested in to what extent did these ideas come from the elderly, were produced by the staff members, or were cooked up by the students themselves.

We believe that the students and, through them, also we the authors hit upon some interesting findings about robots and AI that also other educators ought to find interesting—hence, this chapter, in this book. At the same time as Paula and Jaakko were researchers in the ROSE project, they were lecturers or educators of the students. Within the former context, our approach was emancipatory (Habermas, 1972), their knowledge interest was, and our knowledge interest is, a critical one. We were from the start oriented towards lofty academic ambitions of production of new knowledge on education-work integration, new forms of actions, and new models of practices some of which might prove to be best ones (Lehto et al., 2018). Within the latter context, in a fashion largely unexpected by them or any of us ourselves as educators, we learned what was somewhat against our expectations.

RESULTS

We learned about how to better integrate students' education with the requirements of their future work or the time they would be done with their education. That is, we found it immensely interesting that the students—students specialized or interested in health-and-well-being services across nursing, social work, and business who as of yet had not a full-time job—were so successful in co-creating new robot-delivered assisted-home-care services with nurses, a physiotherapist, and the senior citizens. We believe it is because they were out of the lecture room and at the group home for the senior citizens in Sipoo, Finland.

The living lab we had in Sipoo, Finland was a success in more than one way. First, in its own small way it incurred cultural change in the specific real live environment under study, in this case the Sipoo group home for the senior citizens. Second, this experiment has emerged, at least for us, as a potential exemplar of co-creation and co-design across different actors and their many roles as to some of the possibilities of how robotics can support elderly well-being and services for them; improve, in a technology-enabled way, work life or the amount of time one spends at work; and generate new business ideas for robotic business.

Third, by stimulating interactions between students and other actors, the living helped develop ideas for introducing a robot into a home for the elderly, demonstrating such research-based and learning-oriented cyclic models of how to integrate education and work life as: (a) “enabling,” (b) “planning,” (c) “implementation,” and (d) “evaluation;” (1) “inclusion,” (2) “control,” and (3) “intimacy” (Wicks & Reason, 2009); as well as (A) “practicality,” (B) “involvement,” and (C) “co-creation of activities promoting change.”

Fourth, in inquiring into how the robot was encountered and what it represented to the professionals, we found that the robot was encountered with mixed feelings and in ways that related to “fears,” “benefits,” “more than one use of the robot,” “interaction,” and “ethical issues.” Fifth, the professionals could imagine and propose new service ideas for Pepper, such as that Pepper might (a) “remind,” (b) “warn,” (c) “assist,” (d) “provide stimuli,” and/or (e) “keep in touch with relatives, friends, and service staff.” Sixth, the students, coming from outside the original central actors in the living lab, mere novices in their field, appeared more fluid than similarly educated but more experienced service staff, and imagined and proposed new service ideas on how to employ robots in elderly care in a senior citizens’ home. Two of the students’ ideas—“bingo” and “gym event”—were prototyped for and tested in the senior citizens’ home, while only one of the ideas—to keep in touch—has advanced to the prototyping stage on the side of the service staff’s ideas. Next, we frame our view of how to relate our findings in relations to earlier ones, as well as extend implications for further research and as take-aways for practice.

DISCUSSION

Given aging, costs of home care related to senior citizens are going up. If/When we desire not to lower the quality of care, we need to develop new approaches. Advances in robotics and AI offer possibilities in how to develop such new approaches.

At the same time, emerging forms of new education are questioning (a) what we teach (what is the “right” set of future skills), (b) how we educate (the way in which we teach and assess students), (c) why we teach (that teachers learn certain things or that they learn to learn), and perhaps most fundamentally, (d) who of us ought to teach. In this chapter, to answer such questions, we have presented preliminary findings in the ROSE project, as well as why and how we believe it to be a case in point of the kind of educational forms changes in education that are needed.

It was clear to all of us that students in institutions of higher education are good at searching the internet to retrieve and manipulate information. At the same time, it was not clear to us from day one how the students ultimately appeared not to lose to AI or to be less superior to it in this.

The students were superior to a robot because they had capabilities "design." In comparison to a robot, AI, and their potentialities, the students learned how to prefigure questions and issues that, despite advances in the integration of AI into them, robotics cannot. Human knowledge is still more than data reduced into information, human cognition has not lost its human character (Hutson, 2018). Each individual human, if forced to be driven by only data and information rather than also by kddnowledge, ceases to have capabilities to act and think human. Data and information will begin to rule over him or her, rather than continuing to act like servants (cf. Varian & Shapiro, 1998).

At the same time, this is not to say that over time it will not become clear that robots and AI will begin to be superior to human beings in work tasks that involve learning from experience in accumulation and/or manipulation of large amounts of data (Moyer, 2016; Nightingale, 1998). Search-engine algorithms are acquiring capacities to predict the preferences of individual human beings, enabling the algorithms to personalize results and make them available to other parties for political or commercial purposes (LeCun et al., 2005). The machines transforming into self-learners, acquiring knowledge by processes particular to themselves, applying that knowledge to ends for which it is difficult if not impossible to find a comparable category of human understanding (Kissinger, 2018). These new kinds of machines learn to communicate with one another (Niiniluoto, 2005; Niiniluoto, 2019).

Given the above kind of scenarios, our role as emancipatory and critical researchers gives us pause even when we celebrate scientific and technical progress in robots and AI. Robotics and AI will probably not be "the new electricity," and ought not become "the new alchemy" either (Hutson, 2018). Rather, in our view, there is a need for contextualizing and conceptualizing the meaning of such information. In the spirit of enlightenment, not only traditional verities need to be submitted to a liberated, analytic human reason but also verities delivered by robots, AI, and other information and communication technologies.[3] There is a need to realize that too much focus on information overwhelms wisdom. With too much information, the information turns into noise, and truth is increasingly "post truth," that is, relative. The culmination of this kind of development may ultimately be a world powered by data and algorithms, run by machines, and ungoverned by ethical or philosophical norms.

Rather than us as educators have students retrieve and manipulate information, and lose to robots and AI that will ultimately be superior to them in this, we call for contextualizing and conceptualizing the meaning of such information. We call for taking the students out of the lecture room, and also out of cyberspace, and to where the users are.

Students need to learn to interrogate the real world. They need to learn by making, by doing, rather than by rote. As a rule, the students need to build on information and knowledge relevant to the immediate practical needs of users (whether these users be the students themselves, end users, or service staff that cater to the needs of end users; von Hippel, 2005). Robots and AI must not inhibit reflection. Rather, they must empower both radical and thoughtful reflection. Values ought to be shaped not by the dominance of any within-group introspection, but by critical reflection and requisite variety in consensus. For all its achievements, robots and AI as a complex otherwise will otherwise turn into another problem, adding more to rather than solving problems that exist.

As we have reported on students' co-creation of services for new services to be delivered by robots, the project of robotics and AI as technologies capable of inventing and solving complex, seemingly abstract problems by processes that seem to replicate those of the human mind appears to go far beyond simple automation in the model of an industrial assembly line. Automation deals with means; it achieves prescribed objectives by rationalizing or mechanizing instruments for reaching them. Well-being and other social service in our experience and interpretation, by contrast, establish their own ends and objectives, which they achieve by truly caring for fellow human beings, organic social interaction with them, and co-creation of the particularities and objectives of the service.

To the extent that their achievements are in large part shaped by the above kind of interaction and co-creation with users, the students also learned and stressed after our experiment, that especially AI will be and ought to be inherently unstable. Such as system is in constant flux in how it acquires and instantly analyzes new user input, then seeks to improve themselves on the basis of co-creation and co-development based on such. True, a growing percentage of human activity will, within a measurable time period, be driven by AI algorithms. And, robots and AI may learn to make strategic judgments, and maybe in such a way to be of true help, but only when they will learn or are taught to work with human beings. For the time being, human-to-human contact still matters, and strategic judgments ought to remain as their peripheral function, of which they need to report to human beings meaningfully.

Over time, AI will probably bring extraordinary benefits to medical science and many other areas. At this stage, it makes sense in our view to have students inquire also for themselves as to the limits of applicability of robots and AI in well-being services, rather than automatically have these technologies spread in medicine into surgery, for example. In our view as educators and researchers, robots and AI make for a fine platform for psychological and social activation and stimulation. Our take on this was not to let robots or AI make the same mistakes as human beings run the danger of doing but faster—and in greater magnitude.

CONCLUSION: IMPLICATIONS FOR SERVICE-PROFESSIONAL EDUCATION

In terms of take-aways for educating for work life from our living for participating students, a well as for all others in the living lab, it is worth noting that "robotics" in our living lab at first was encountered negatively, it was too radical a proposition. In contrast, the idea of an individual robot was a more appealing one. To co-create services together with senior citizens and service staff served to further naturalize what was originally difficult to approach. Finally, to approach in the above ways a robot served paradoxically to increase interaction between human individuals.

Thus, while traditionally, personal service has been taken as a nonnegotiable element of a client's user identity and a service professional's work identity, the students and we learned that students appear very good at interviewing elderly people in order to grasp the meaning of how robots such as Pepper (social robot) can be applied in order to support elderly people's health and well-being. The students were even better at this than the service staff or we as researchers. As still outsiders to the health and welfare system, the students learned faster than anyone else, unconstrained by any need to unlearn.

It was based on the work of the students in the focus groups with the nurses, the physiotherapist, and the manager that software could be coded and their use pilots could be designed. The plan for the pilots such as Bingo and Gym were planned and checked by the physiotherapist.

After coding, the pilots proved to us researchers that the cooperation with the elderly people and service staff was still important in planning to apply robotics in elderly care. The role of the students was useful and evident when new trends such as robotics were transformed in real life context. We researchers and educators were important to the nurses, the physiotherapist, and the managers—as well as to the senior citizens—in that we did not come and go as did the students, but represented continuity, working together, and trust.

We believe our experiences with the students also provided new knowledge and competences on how to approach education for AI. After all, AI, through already foreseeable advances in information and communication technologies and digitalization and robotics will certainly pervade robotics, too. The students, the staff, the senior citizens, and we all learned that robots and AI can misinterpret human instructions due to their inherent lack of context.[4] Some colleagues, more in the technology or economic worlds than we, claimed that our living lab was ill-conceived and poorly executed, but to us it illustrates an underlying ambiguity: To what extent do we need students to understand that it is important to have AI comprehend the context that informs its decisions and judgements?

In our view, AI and robots must not change human thought processes and human values. Where in most social interaction, a human player may seek to win, but also to learn new strategies potentially applicable to other life dimensions. For its part, by contrast, AI knows only one purpose: to win. It "learns" not conceptually but mathematically, by marginal adjustments to its algorithms. We must remember to make sure that the students we prepare for work life remember to work less single-mindedly than does AI (Carr, 2008). What we need in healthcare, for well-being, is a mindset of working together, not a mindset of competition.

Also other educators, in our view, should ask themselves some of the questions the students and we have raised here in order to build answers into their efforts. Governments should consider employing eminent thinkers to help develop societal visions. This much is certain: If we do not start such efforts soon, before long we shall discover that we started too late.

NOTES

1. Generally, a living lab can be defined is a research setting where people, artifacts, and a working environment are networked to integrate user-centered views and co-creation in a spirit of ideation and open innovation (cf. Leminen, 2015; Hossain et al., 2019).
2. The Turing test is a test of a machine's ability to exhibit intelligent behavior. At the time of writing this chapter, in 2018, no physical robot had of yet passed the Turing Test. Cleverbot, a chatbot or software robot, passed it in 2012 (Stanford University, 2016). Other signs of the coming age of AI by 2018 include estimates that AI is by 2020 estimated to be among the top 5 investment priority for more than 30% of CIOs. Artificial Intelligence is forecasted to reach human levels by around 2029. Some 800 million jobs are likely to disappear and be taken over by machines by 2030 (Kissinger, 2018).
3. Decisions and judgments made in a driverless car—which is likely to be prevalent on roads in a decade—can be taken, for example, to highlight differences between human decisions and control, on the one hand, and the universe AI seeks to navigate, on the other. This raises interesting questions, such as what will happen when such a car is obliged by circumstance to choose between killing a senior citizen and killing a child (cf. Kissinger, Schmidt, & Huttenlocher, 2019; Kissinger, 2018).
4. A famous recent example was the AI chatbot called Tay, designed to generate friendly conversation in the language patterns of a 19-year-old girl. But the machine proved unable to define the imperatives of "friendly" and "reasonable" language installed by its instructors and instead became racist, sexist, and otherwise inflammatory in its responses. Artificial Intelligence, left to its own devices, deterministically developed slight deviations that, over time, cascaded for the worse rather than the better (Kissinger, 2018).

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PART III

TEACHING SKILLS THAT MACHINES AND ROBOTS CANNOT DO: THE CHALLENGE FOR BUSINESS AND MANAGEMENT EDUCATION

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CHAPTER 7

HOW CAN WE REINVENT BUSINESS EDUCATION?

Applying the Professional Service Life-Cycle Perspective to AI-Enabled Learning

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In its inaugural report on the broader implications of advances in artificial intelligence (AI), the Stanford University-led One Hundred Year Study on Artificial Intelligence Project identified the meaningful integration of AI technologies with face-to-face learning as a primary challenge for the field of education (Stone et al., 2016). In this chapter, we address this challenge by applying a life-cycle perspective on professional service work (Lawrence, Zhang, & Heineke, 2016) to an AI-enabled learning context in which technology and human service providers collaborate. This life-cycle perspective helps clarify key contributors to this challenge, including shifts

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in employment, changes in learners' needs, and the dynamic educational processes that connect the two. It also sheds light on the path to more effective and efficient management education.

The theoretical underpinning of this chapter comes from our study of an emerging professional service in the green building industry and associated changes in the nature of work over time (Lawrence et al., 2016). In studying the development of a leadership in energy & environmental design (LEED) consulting service, we created a model we call the Professional Service Life Cycle (PSLC). Each of the model's stages (innovation, validation, diffusion, and commodification) and transitions yield important insights related to rethinking, retraining, and redesigning business education in the age of AI. In this chapter, we explain how our PSLC model elucidates the evolving roles that education providers and AI-based services will play in reaction to various market forces and consumer demands.

We conceptualize educational service-facilitated learning as a co-created experience between learners and education service providers (Sampson & Froehle, 2006; Vargo, Maglio, & Akaka, 2008). Today, learners are expected to master 21st-century skills that are instrumental for solving "complex real-world problems . . . that are nonstandard, full of ambiguities, and have more than one right answer" (Alberts, 2013, p. 249; Marshall & Tucker, 1992). Such an expectation demands educational services innovations that offer lifelong learners personalized yet cost-effective experiential learning opportunities. Our PSLC model explains the tensions and dynamics of a collaborative service system with technological and human education resources, offering insights on how to promote and manage such systems efficiently and effectively.

The remainder of the chapter is structured as follows. We first provide an overview of the PSLC model by explaining how technological and market forces have changed professional service work patterns. We then apply the PSLC model to explore how education service organizations can embrace these changes, analyze workflow, and create teams with a blend of technological and human capabilities. Next, we discuss how to address barriers to embracing changes in professional service work in business education and how to manage transitions between PSLC stages. We conclude on an optimistic note, asserting that the PSLC model can help organizations proactively navigate the changing landscape of professional work in business education and successfully realize value propositions for learners.

PROFESSIONAL SERVICE WORK: THE LIFE CYCLE

Services comprise just over 80% of the U.S. economy (Henderson, 2015), professional work encompassing much of the work done in each service-industry subsector. We define *professional work* as processes that rely on specialized training to solve specific, often unique, problems in fields such as architecture, engineering, finance, law, medicine, and higher education, among others. Traditionally conceptualized as highly interactive, customized, and labor intensive (Schmenner, 1986, 2004), professional work encompasses elements of high-knowledge, high-discretion work and elements of more routine work (Lawrence et al., 2016; Lewis & Brown, 2012), as represented in the vertical axis in Figure 7.1. Along the horizontal axis, technology and people supply a continuum of expertise. Figure 7.1 depicts a continuum of professional service work that includes a dynamic mix of creative and standardized processes completed by a combination of technological and human resources. Its four quadrants compose a single contiguous space in which each position represents a certain combination of task and talent. In the last decade, technologies harnessing the power of the Internet and enabling sophisticated AI have promoted work redesign and changed the professional service landscape.

As the costs of professional services, including business education, continue to soar, market forces have challenged the status quo and spurred the development of technological applications that enhance the work of

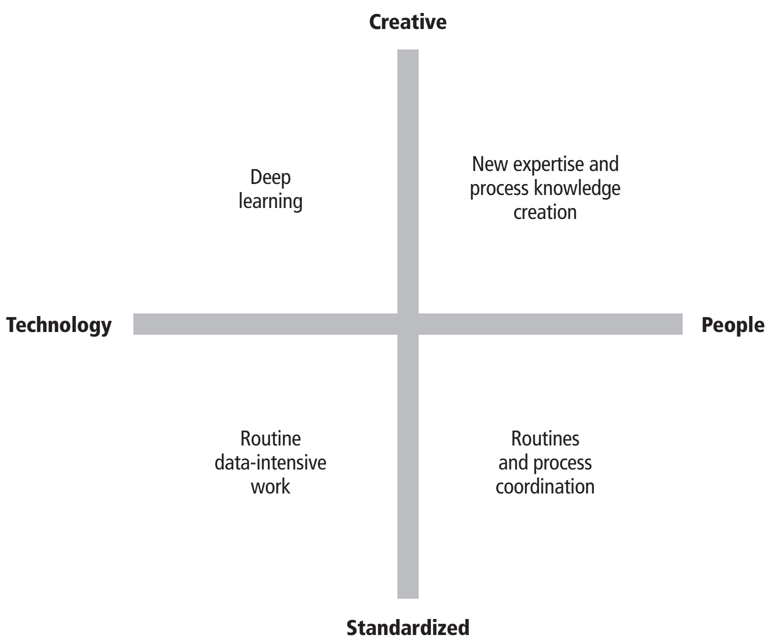

Figure 7.1 A simple representation of professional service work in an AI-enabled workplace.

the professional. Our research suggests that professional service organizations (PSOs) could meet rising performance expectations by following a "focused factory" strategy (Skinner, 1974) in which a *professional team* collaborates to deliver high-quality outcomes with high resource utilization. Figure 7.1 offers insights on how such a team may form by including expertise at different levels in terms of technology and human talent. The right half of the graph shows an existing PSO approach in which routes are delegated to paraprofessionals, allowing professionals with more specialized and advanced training to focus on creating new expertise and knowledge. The left half of the graph illustrates how digital technologies could further augment human professionals' capabilities by leveraging machine-learning and data-mining capabilities. The top-left quadrant involves deep learning, which is quickly emerging as computer algorithms gain higher, more creative cognitive capabilities. The bottom-left quadrant represents the growing application of data processing capabilities.

The PSLC model exhibits several distinct features. First, new approaches continuously emerge from experiments that professionals conduct in search of better solutions. They then share the results with other professionals, typically a professional association or external audience that validates and verifies their effectiveness. The extent of that validation, we have observed, is greater when the information asymmetry between the professional and the client is more pronounced.

Unlike the product life cycle (Day, 1981), which spans birth and growth to maturity and decline, professional services evolve from highly variable and creative processes to less-variable processes that can more efficiently and effectively serve a broader client base. This is necessary because of the competitive nature of the marketplace. Technological advancement, meanwhile, makes it possible to embed the standardized approach in software and/or hardware and make it available to still more clients. This accelerates the transition to a routinized service that less-skilled providers or devices embodying this knowledge can conduct. As some ideas become more standardized, professionals begin to focus more on the creative aspects of their service to clients, beginning the life cycle anew—this time with new approaches, validation, and dissemination. Figure 7.2 depicts this professional service work evolution.

Stage 1: Innovation

Professional services require specialized knowledge and autonomy because of clients' idiosyncrasies. High variability in client inputs cascades throughout the process because unique problems call for customized solutions, often with personalized outcomes. From an operations management

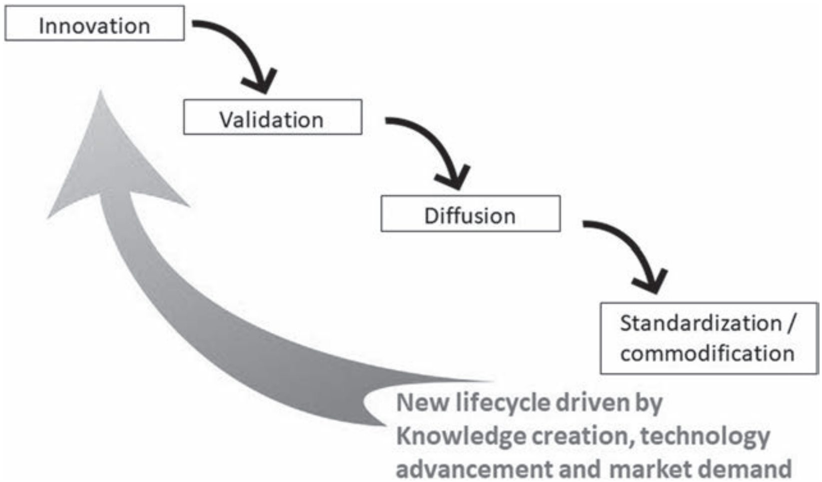

Figure 7.2 The professional service lifecycle.

standpoint, the implications of high variability are twofold. On the one hand, high variability constrains process efficiency because it hinders a smooth and even workflow (Schmenner & Swink, 1998). On the other hand, high variability naturally generates experimentation that may spur innovative solutions. This inherent tension between low-efficiency and high-creativity requirements makes it necessary to preserve professionals' innovative capacity by continually evaluating and shifting tasks that can be routinized or outsourced to another individual at a lower cost.

Stage 2: Validation

Because of their expert knowledge base, services that require a high level of professionalism require a higher level of client trust. As such, they typically undergo more rigorous validation to mitigate the impact of knowledge asymmetry. The peer-reviewed journal publication process, for example, is one mechanism to validate university professors' research findings. Professional associations also play an important role in endorsing new ideas. Customers may have access to customer evaluations of all kinds of service experiences, but clients' ability to evaluate the technical performance of professional services is still limited. As a result, accreditation agencies such as the Association to Advance Collegiate Schools of Business remain important. Professionals initially may feel threatened by routinized elements of their work, but as the life cycle progresses, they should grow accustomed to working with paraprofessionals or algorithms embodying some of that knowledge. By letting go of more routinized work, professionals can focus more on that which requires greater expertise and creativity.

Stage 3: Diffusion

While professionals develop and validate new knowledge, organizations play critical roles in diffusing it. Professional associations promote information that diffuses technological developments among members and help shape professional behavior norms. This diffusion process is likely to meet the resistance of professionals who prefer their own processes. Our research into the LEED consulting service found that U.S. government systems and universities have been early LEED-standard adopters. These pioneers facilitated the diffusion of LEED standards by pushing for policies and regulations favoring sustainable building designs and stipulating sustainable new-construction requirements. Information-sharing technology has further hastened such diffusion. When service innovations provide value, market forces help diffuse innovative services that reduce costs and improve delivery.

Stage 4: Standardization

As a service process becomes more standardized and its outcomes more predictable, performance priority shifts to conformance and cost efficiency. For example, standard operating procedures and checklists may emerge to effectively and efficiently address performance priority. This is an important departure from the situation earlier in the life cycle, where experts' creativity and autonomy enhance performance by solving new problems. While it may threaten existing professional services, this routinization also frees up resources, allowing professionals to focus on more creative, higher-order work that may drive further innovation. Tasks deemed professional may evolve as the result of standardization, but the domain of professional services remains highly creative with its purpose of customizing work processes. Routinized services can be shifted to less-skilled workers (including customers) who can perform them more economically. Alternately, these services may be standardized for efficient delivery, giving the professional more time to focus on elements requiring more knowledge and discretion. This process benefits society as it increases cost-effective options available to consumers and improves process conformance quality.

To summarize, the findings from our longitudinal LEED consulting service case study (Lawrence et al., 2016) detail how professional service work has progressed from creative work with high occupational discretion and autonomy to work that can be standardized. Customer demand for efficiency and effectiveness in a competitive marketplace ultimately drives this progression, a pattern also observable in a business education context. Furthermore, our PSLC model offers insights on rethinking, redesigning, and retraining primary elements of the business education system to enhance its value proposition.

RETHINKING BUSINESS EDUCATION WITH A PSLC PERSPECTIVE

Shifting to the world of business education, we begin by asking the following question: "What skill set must business professionals have in an AI-enabled world?" A PSLC perspective suggests that technological resources will perform more professional service work. This would create a dynamic work environment that will demand management/business education graduates command lifelong learning capabilities; high emotional, social, and cultural intelligence; critical thinking and communication skills; and the knowledge to interact with and create new technologies that propel the life cycle. The recent decline in MBA enrollment signals an increasing focus on specialization and customized education that meets the current needs of businesses and students (Gee, 2017). To this end, programs have emerged that offer stackable, customizable credentials seeking to meet the needs of a rapidly changing business environment. The University System of Georgia recently approved a new "Nexus" degree focused on hands-on experiential learning. The degree will require 18 hours of coursework, six of those comprising experiential learning opportunities. Existing Nexus degrees include coursework on blockchain and machine learning, cybersecurity, and financial technology (Stirgus, 2018). These degrees are designed to be standalone, for students previously out of school for some time, and compatible with a portfolio of classes that integrate for additional degrees.

One consequence of accelerating technology development (Kurzweil, 2004) is the need to quickly and continuously update the skill set required for employment. "Nanodegrees" such as those offered by online course providers Udacity and EdX harbor the potential to support such lifelong learning. Facebook, for example, recently announced the PyTorch Scholarship Challenge, where the social networking firm pays Udacity to offer students a 2-month course on building, training, and deploying deep learning models, then hires graduates who can demonstrate mastery (Rayome, 2018). An ever-evolving, focused education model that supports specialized, continuously updated knowledge would be appropriate in this context.

In response to the technological advances driving work requirements, business schools at institutions such as Stanford University, Harvard

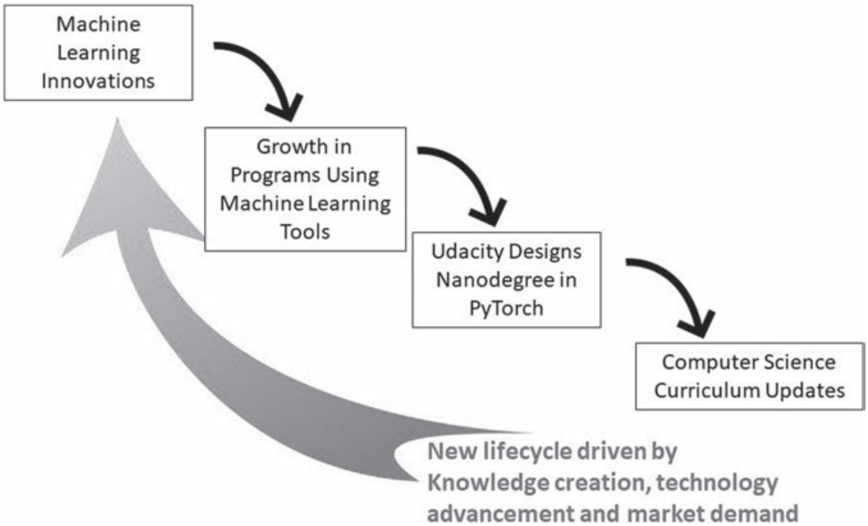

Figure 7.3 Education services of the future—Specialized lifelong learning.

University, and New York University are increasingly focusing on emotional intelligence as an admissions criterion (Allen, 2018). According to a World Economic Forum (WEF) "The Future of Jobs" report, "Social skills—such as persuasion, emotional intelligence and teaching others—will be in higher demand across industries than narrow technical skills" (WEF, 2016, p. 22). With ready access to information, schools should focus on multi-sensory experiences that help foster creative solutions rather than easily automated rote learning and memorization. We do not suggest faculty should ignore technology; rather, they should utilize its functionality to free up time to increase personal interaction and expand spaces for creative thinking. Experiential classes that foster such learning, such as Harvard's Field Foundations courses, are expensive because they require industry coordination and hands-on faculty participation. Skillsets that facilitate student engagement and cross-disciplinary industry coordination, moreover, are not traditionally found in business school professorial faculty. Their development must become a priority for institutions looking to thrive.

REDESIGNING BUSINESS EDUCATION BY LEVERAGING PSLC INSIGHTS

To fulfill the promise of preparing future-ready professionals, business education processes must be carefully redesigned (WEF, 2016). Extensive research has shown that the success of formal education is associated with individual students' characteristics as well as those of their families, schools, and communities (Rumberger & Lim, 2008). Student demographics, meanwhile, are shifting: Thirty-eight percent of today's college students are older than 25, 26% are raising children, 47% are financially supporting themselves, and those in Generation Z (birth-year ranging from 1995 to 2010) are reaching college age (IHE, 2018). These changes require corresponding talent- and task-mix redesign for strong institutional support and a personalized learning approach.

The PSLC model once again sheds light on how to manage this process change. The implications of a dynamic mix of technological and human resources, as well as the mix of creative and routine tasks, could engender robust processes for successful learning outcomes. We leverage two case studies to explore a PSLC-guided process redesign. The first case study demonstrates how AI technologies contribute to the redesign of institutional support services in higher education. Specifically, an advising platform driven by a predictive analytics engine enables the staff at a large public university to provide personalized guidance on academic requirements and appropriate strategies and resources to support degree completion. The second case study demonstrates how AI may lead to changes in individual learning processes and facilitate higher academic achievements. In this case, learning analysts and instructors team up and obtain insights from the learner behavior data collected in web-based learning management systems to help learners adopt more effective learning strategy for specific course content. Together, these two cases demonstrate how the administrative and academic processes in higher education could evolve by combining human and technological resources to deliver better learning efficiently.

Support Learning With Personalized Attention

Georgia State University (GSU) faced a major challenge when it decided in 2010 to increase its graduation rate: Its student body not only is among the most diverse in the United States, but also the most economically disadvantaged. Early detection, coupled with personalized and timely interventions when a student went off course, was not achievable until a technology-enabled advising platform redesign was implemented to address the issue of scale (Fausset, 2018). Currently with 51,000 students enrolled, GSU continues to improve its graduation rates by offering customized interventions through technological innovation. Applying PSLC insights, we show in Figure 7.4 how the new GSU advising platform leverages an effective mix of technologies and human resources to complete the various tasks required to maximize the chances of success for a large, diverse, and economically disadvantaged student body.

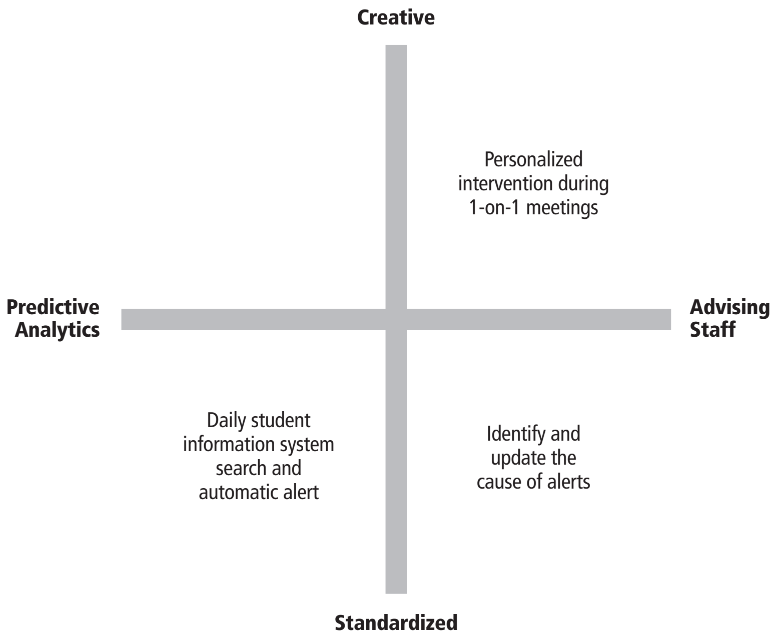

Figure 7.4 Talent and task mix of a scalable university advising platform.

Conducting student information system searches and sending alerts from advising staff at GSU were time-consuming tasks nonetheless easy to routinize using predictive analytics. This critical design choice has contributed to a scale increase in which predictive analytics routines offer nearly real-time monitoring of student records and advisors work with students to address identified problems. Georgia State University worked with an education consulting firm to develop the platform, but the lion's share of the project expenditure however went to hiring more advising staff; this ensured automatic alerts were handled through personalized intervention. Dedicated personnel also were needed to profile problems and update search phrases for predictive analytics.

Engage Learners With Adaptive Education

Research has suggested that teachers can help their less-successful students improve performance by paying more attention to "good learner strategies" (Rubin, 1975). As university education shifts to information sharing, communication, and collaboration capabilities facilitated by web-based learning management systems (LMS; Romero, Ventura, & García, 2008), identifying and engaging less-successful students increasingly requires expertise from information technology, data science, and learning. Using a PSLC lens, we analyze the professional team's talent mix and the evolutionary process of standardizing efforts to help less-successful students.

An LMS is a software application for the administration, documentation, tracking, reporting, and delivery of educational courses or training programs. Often invisible to typical LMS participants, including instructors and students, is the large amount of log data tracked in re-coding student activities such as reading, writing, test taking, and peer communication. These behavioral trace data offer insights into how students learn, which can inform the development of adaptive learning contexts. Figure 7.4 illustrates a scenario in which the emerging learning analyst profession creates knowledge in this domain, working with key stakeholders to innovate and develop new ideas into standardized processes for improving learning outcomes.

In this scenario, a learning analyst reviews learning behavior log data and assesses the effectiveness of a student's learning strategies for the topic at hand. This work is highly innovative because it draws on know-how from information technology, data science, and learning theories. The analyst can work individually or with a software engineer to develop a dashboard that gives an instructor student-level behavior analysis. The instructor provides crucial input during the validation and refinement of this new dashboard function, while other campus instructors adopt it to improve learning outcomes. Over time, LMS vendors become aware of these innovative practices and incorporate the most successful ones into their standard offerings. Figure 7.5 illustrates this dynamic process.

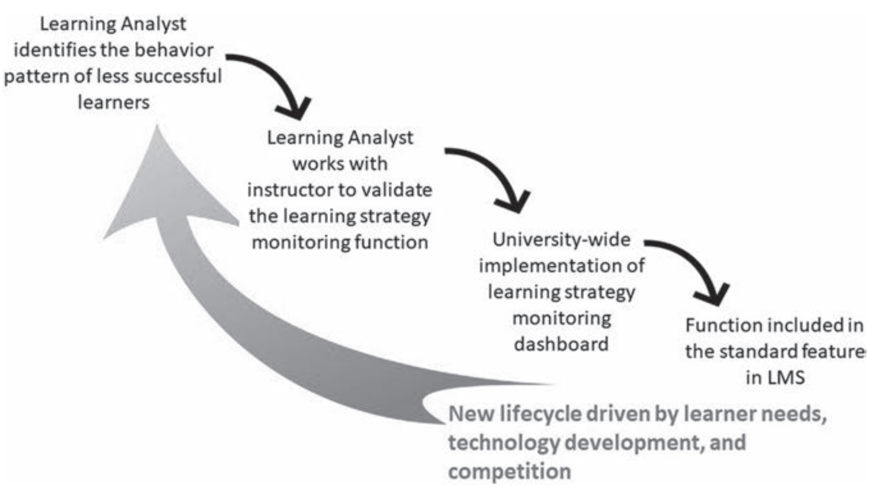

Figure 7.5 The lifecycle of adaptive learning professional work to engage and develop lifelong learners.

Retrain Education Service Providers to Support PSLC

Rethinking curriculum and redesigning business education processes also entails reimagining the business school faculty. From a content perspective, an interdisciplinary curriculum will require hiring faculty with a varied skill set spanning multiple disciplines. From a pedagogy perspective, working with a learning analyst also requires faculty members to understand education theories and demonstrate a competency in designing and using educational tools. Hiring faculty with interdisciplinary skills or creating faculty "clusters" to address multi-disciplinary issues, however, can be challenging (McMurtrie, 2016), given disciplines' tenure requirements and institutions' resource constraints. Even more challenging is reimagining the classroom environment, traditionally led by tenure-track faculty experts in a highly specialized, noneducation subject who are rewarded for creative research endeavors, not teaching. The PSLC model suggests that specialization and integrated teamwork can address these challenges while the higher-education community grapples with the future of its tenure and faculty evaluation systems. In the business school context, PSLC envisions two specializations that faculty members self-select based on their passion, working with a mix of human and technological resources to create societal value.

One specialization emphasizes creative academic research, recognizing that faculty must remain domain experts and conduct cutting-edge research. Following the prediction of the PSLC model, findings from these cutting-edge research efforts must be validated in practice. Over time, verified insights can be standardized and incorporated into the business curriculum. During this life cycle, the faculty member collaborates with practitioners and the curriculum design team to ensure the content remains relevant.

The other specialization, which focuses on the delivery mechanisms that engage learners, is best suited for star teachers who constantly innovate and design creative experiential learning opportunities. These educators have a solid understanding of curriculum-prescribed content and know the learner well enough to provide essential input to learning application designers and learning analysts. By doing so, they are able to propel the life cycle of innovative pedagogical practices to become best practices and algorithms in the learning platform.

It becomes clear that appropriately allocating resources in a team approach is important for supporting specialization. Resources need to be structured in such a way that the validated findings from creative academic research or creative delivery mechanisms in teaching are passed onto other team members for further standardization and commoditization. This approach contrasts with the standard delivery of content in a lecture-style classroom format or the overreliance on poorly paid part-time adjunct faculty (Kezar, Scott, & Yang, 2018). Competing in the future business education marketplace will require value creation through content enrichment and cost reduction, and both specializations play essential parts in implementing this approach.

To summarize, we envision education services of the future through a PSLC lens as follows: Education service innovations occur in both educational content and delivery. Once tested, these innovations must be routinized to become part of online learning platforms. A team, consisting of researchers, teaching experts, and online learning platform developers, is critical to ensuring innovations translate into a rigorous curriculum. Successfully deployed online learning platforms, student tracking systems, and AI-enabled teaching assistants will, in turn, free up researchers and teaching experts to focus on continuous innovation in their areas.

We now turn our attention to how organizations can leverage insights from the PSLC to strategically position their organizations to tackle the new educational landscape.

OVERCOMING BARRIERS AND STRATEGICALLY POSITIONING THE ORGANIZATION

Organizational inertia and external forces aimed at protecting the domain of the profession can leave PSOs, specifically higher-education institutions, ill-equipped to deal with the rapidly changing AI-enabled learning landscape. Using a PSLC-enabled perspective can help universities and business educators be proactive in overcoming barriers to change. It is imperative to strategically position the organization by balancing competencies of the professional team, designing holistic student experiences, and adapting professional knowledge and behavior standards to changing times.

Artificial Barriers to the Life-Cycle Progression

Our discussion of life-cycle stages addressed barriers that can slow its progression in educational institutions. Some barriers naturally occur due to the knowledge-intensive nature of professional service work. Education professionals should be aware of artificial barriers that do not serve students' interest and focus on overcoming these to stay competitive. Table 7.1 identifies such barriers, along with their remedies.

Broadly speaking, three types of artificial barriers exist. First, artificial barriers often result from professionals' need for control and self-protection while facing perceived uncertainty over the next life-cycle stage. This manifests, for example, in universities or professors resisting online learning technologies in favor of standard lecture-style formats. Second,

TABLE 7.1 Artificial Barriers to PSLC Progression and Ways to Overcome Them

Stages Impacted	Artificial Barrier	Ways to Overcome the Barrier in Business Education
Innovation	Risk avoidance due to fear of service failure	Reward creativity and allow for failure. Extend tenure clock for research active faculty showing progress. Provide teaching faculty resources to innovate in the classroom. Increase number of full-time teaching faculty focused on innovative/technological solutions rather than simply information dissemination. Encourage cross-disciplinary teamwork that incorporates technological innovation.
Validation/ Diffusion	Professionals' unwillingness to relinquish autonomy	Stimulate knowledge sharing with the broader team of service providers and with students. Partner with industry to test and validate innovation in pedagogical and field-specific research. Reward research faculty that collaborate with practitioners to validate their work. Hire boundary spanners that can bridge the gap between academia and industry.
Diffusion	Professionals' unwillingness to adopt new practices	Listen to faculty and staff to understand their fears of adoption; work to enhance the value of innovation. Provide incentives to diffuse innovations via technology transfer and commercialization of innovations. Reward faculty that have their innovations adopted by industry and academic communities.
Innovation	Professionals occupied by routine tasks	Redesign process to take advantage of standardization and free time for professionals to focus on tasks that require more of their expertise. Hire learning analysts and implement Learning Management Systems that help reduce the burden of routine class and student management. Reward both innovations in classroom pedagogy and research.
All	Bureaucracy; complex service delivery network	Deregulate the profession; leverage data, communication and computing technologies.

professionals may resist innovations that demand a significant initial time and effort investment, perceiving that they drain time for delivering personalized attention to students. Finally, some professions suffer from higher levels of bureaucracy, which can attenuate the market signal for more efficient and effective services. In practice, this exists in university tenure systems that front-load research and focus on narrow academic scholarship over practically relevant cross-disciplinary research. Regardless of how any one professional organization addresses these barriers, the life cycle nonetheless continues. Other professionals will shift their practices to focus on the more innovative, challenging aspects of the service, growing more efficient and competitive as they broaden the service team and employ technologies. A proactive approach that overcomes life-cycle progression barriers will serve PSOs' long-term interest well.

Applying our life-cycle model to education allows us to explore challenges and opportunities in operations management as technology propels professional service work through its life cycle. We next discuss contextual factors affecting the speed of the professional service work life cycle.

Just as aspiring lawyers' career prospects have dwindled, so has the outlook for newly minted PhDs seeking careers as tenured professors (Kolata, 2016). The higher-education delivery model in the U.S. market has remained relatively unchanged, with twin goals of original knowledge creation and dissemination through teaching. Universities' massive online open courses (MOOCs), though maligned by some, still hold promise to disrupt higher-education knowledge dissemination by reaching a theoretically unlimited number of learners online. This innovation, which relies on a model of online asynchronous instruction, has suffered from consistently low completion rates. Online master's degrees from established universities such as the Georgia Institute of Technology that follow a MOOC format, however, hold real promise in reducing costs and increasing access. They do so by combining efficient delivery of standardized knowledge with effective curriculum design that meets market expectations. Even if MOOCs do not replace professor–student interaction, leveraging them to deliver content in an engaging way frees professors to use the classroom for more active and applied learning experiences.

The real challenge of higher education lies in managing a mix of creative and routine tasks that accomplish the goal of learning. That is, professionals with higher degrees are charged to expand their field through theoretical and pedagogical innovations *and* to disseminate knowledge through instruction. This model suffers from two flaws. First, these professionals typically are trained with heavy emphasis on research, less so the skill sets and/or practices for effective undergraduate instruction. Second, innovative activities are intrinsically risky, requiring significant resources with no guarantee for the output. As a result, prestigious research institutions are known to delegate teaching responsibilities to teaching assistants and adjunct faculty in an effort to protect tenure-track faculty members' research productivity. From a PSLC perspective, applying specialization and routinization offers a pathway to improving education quality and reducing cost. Dual silos for instruction and research, however, are not the answer; creative, innovative solutions are required in both knowledge creation and dissemination. A team approach that uses human and technological talents holds promise. For example, AI teaching assistants (Korn, 2016) can handle routine questions with almost infinite capacity, again freeing up time for professors to innovate in content and pedagogy.

Evaluating and Rebalancing Competencies

A direct consequence of service work progressing along the PSLC is the profession's mix of discretionary processes and routines at any given time. Effectively managing this mix requires a two-pronged approach:

1. When a guideline for the task at hand exists, standardize.
2. When uncertainty precludes clear guidelines, motivate professionals to use their discretion in a way that aligns with the performance objective of the organization.

Managers of PSOs should focus on the following:

1. Regularly assessing the professional team, consisting of both human professionals and digital technology-based solutions.
2. Continuously analyzing the workflow to match team members with the changing requirements of the professional service work.
3. Designing and revising the process to support collaboration across the team of professionals and digital technology capabilities.
4. Coordinating the transitioning of tasks as work evolves.

In teaching foundational business courses, for example, a good understanding exists of the necessary elements of a good syllabus; standardized syllabi can contribute to stable and high-quality course planning. Individual instructors, however, retain high levels of autonomy in delivering the content because they can customize in-class interactions with students according to their background and experience. So long as the instructor aligns with the institution's teaching excellence mission and the course's learning objectives, customizing course delivery based on his/her strengths benefits both the learners and the institution. Teaching activities around some courses (e.g., Introduction to Operations Management) could advance further along the PSLC by standardizing content delivery and tasking the instructor to focus on helping individual students acquire content mastery. Here, the classroom is a vehicle for learning application, not merely knowledge transfer, making the instructor a "guide on the side" rather than a "sage on the stage." This alternative role may require retraining or a team-based approach involving multiple players with varying skills.

Efficiently leveraging outside expertise can further expand organizational capabilities, especially for late-stage life-cycle tasks with measurable outcomes. Outsourcing process expertise also may help solve PSO managers' "cat herding" problems. For example, having a learning analyst take charge of task coordination and documentation enhances communication and collaboration among education project team members. Universities also should partner with companies and develop long-term symbiotic relationships that help retain university research capabilities while assisting with the application and diffusion of innovations (Lutchen, 2018).

Improving Experience Design

Although we argue that technology will have a major impact on the work of the professional, this does not mean that the interface with the consumer (i.e., student) is less important. On the contrary, one of the benefits of standardization is outcome improvement, including customer satisfaction. A PSLC perspective focuses the team on a customer-centric experience by rationalizing each task and coordinating process flows. First, the PSLC helps identify routine tasks that are candidates for evidence-based standardization; this reduces variability, cuts costs, and improves productivity in the long run. A prime example of this is the aforementioned GSU system that identifies at-risk students. Second, the PSLC calls attention to potential information gaps as tasks transition from creative to standardized, necessitating talent allocation changes. Proactive actions focusing on improving sequencing, along with transparency of material and information flows, help both employees and customers. Studies have shown a positive correlation between more informed customers and higher satisfaction ratings (Katz, Larson, & Larson, 1991). Third, analyzing activities with high variability in their input, process, or output—typically service work in its early PSLC stage—may identify opportunities for variability reduction. Iterations of process analysis and improvement create processes that efficiently and effectively meet customer demand. These processes also tend to perform better in highly variable and uncertain situations because they are more effective against risk factors such as emergencies and unplanned procedural changes (Gawande, Studdert, Orav, Brennan, & Zinner, 2003).

Evidence strongly suggests that focusing on processes has contributed to better information, material, and patient flow; error reduction; and overall patient care improvement (Kim, Spahlinger, Kin, & Billi, 2006).

Managing Professional Governance

The professional community drives the PSLC by providing self-governance in terms of both professional knowledge and behavior standards. On the knowledge side, the professional society validates new ideas and generates guidelines for a particular form of service work. The percentage of practicing professionals conforming to the guidelines, however, may be rather low. The PSLC offers a system-level explanation. As standardization moves service work through the professionalism continuum, the work is more likely to be codified in a device or more efficiently completed by professionals ranking lower on the professionalism continuum. Such routinization naturally threatens the status of the profession. As a result, little incentive remains for professional societies or, in the case of education, The Academy, to actively push for the diffusion of standardization. This is despite the fact that creating such guidelines may be vital to maintaining a consistent knowledge base for the profession.

CONCLUSION

Isolating a higher-education institution from various technological drivers of change is not a survival strategy. Even in a barrier-rich marketplace like education, value-seeking customers will drive innovative solutions that undoubtedly will involve technology. Routine scripted service encounters and process work always have and always will be a part of the PSO. What will change, however, are the agents performing such tasks. Outsourcing routinized tasks to human counterparts remains one option, but significantly more potential lies in the analytical abilities of AI. We will not replace university professors—but we will replace some of the tasks they do and enhance others. The organizations that will prevail are those that can most efficiently manage the myriad tasks of the profession and allocate them to the team members, human or otherwise, that deliver the highest quality service at the lowest cost. Whatever change may come, professionals can continue doing the innovative work that pushes the life cycle forward.

ABOUT THE RESEARCH

We conducted an exploratory industry case study of a specific professional service to investigate how professional teams and their work change over time in professional service organizations. Leadership in Energy & Environmental Design (LEED) consulting, a new professional service that has developed over a short period of time, allows us to observe multiple iterations of life cycles and explore the forces that underlie this innovation-standardization tension. Specifically, we sought to answer three questions: (a) "How does the knowledge base of the profession develop over time?"; (b) "How does the professional community change?"; and (c) "Are there discernible changes in professional teams' work patterns?"

We collected data from secondary sources including whitepapers, newspaper articles, and LEED publications as well as primary qualitative data from semi-structured interviews with LEED professionals. Questions revolved around the LEED professional's work and how this has developed over time. We purposely sampled LEED professionals to gather a range of perspectives among different types (e.g., architects, engineers, interior designers) with varying levels of accreditations (e.g., LEED Green Associate, LEED AP).

Our case evidence demonstrated an inherent tension between innovation and standardization/commodification in LEED professional work, resulting from multiple demands through various developmental stages. We developed the PSLC model to illustrate these changes in work over time and detail the external demands driving their evolution.

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CHAPTER 8

DECONSTRUCTED EDUCATION

The Usefulness of Smart Teaching

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Teaching must include innovative methods to improve the quality of students' education and motivation for learning (Ferrari, Cachia, & Punie, 2009; Fullan, 2011; Riga, Winterbottom, Harris, & Newby, 2017). Hand in hand with technological innovation, teaching methodologies are foreseeing more and more modern approaches, such as flipped classrooms (Arnold-Garza, 2014) or gamification (Day-Black et al., 2015), some of which focused on teaching methods for distance learning students (Borisova, Vasbieva, Malykh, Vasnev, & Bírová, 2016). As well as the companies' smart working—that is the way of execution of a job relationship characterized by

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the absence of time or space constraints and by a work organization settled by phases, cycles, and objectives (Klehe & Anderson, 2007)—also learning places can and must be characterized by similar practices to improve the student learning experience.

Over the last few years, the speed with which companies and businesses experienced change continued to accelerate and today's technology was inconceivable even a few years ago. However, the process of change has also been influenced by social and economic forces. Indeed, technological, social, and economic forces are not isolated but strictly intertwined parts of the context in which we live and work. (Dirican, 2015; Mitchell & Zmud, 1999; Orlikowksi & Barley, 2001).

Digital transformations have modified the role of people in organizations with a significant impact on social behaviors, organizational change processes, training policies, and knowledge activities (Barnes, 2012; Mitchell & Zmud, 1999). Many scholars considered the relevant role and the impact of information and communication technology (ICT) in education programs. Also the field of education changed over the years because of the forces mentioned above that affected and shaped its boundaries and contents (Kozma, 2005; Sang, Valcke, Braak, Tondeur, & Zhu, 2011; Tondeur, van Keer, van Braak, &Valcke, 2006). These forces are ever-changing and interacting, challenging educators to keep updated on the trends, technologies, and resources available while enabling self-directed student learning. Graduates who are self-directed learners understand and are much more responsive to system changes when they are in practice and out of the learning setting, where they are no longer "protected" by faculty members with whom to consult (Mama & Hennessy, 2013; Zhao, Pugh, Sheldon, & Byers, 2002).

In this context, educators, as connectors of the fields of practice and education, need to be knowledgeable about changes in practice and technology in both fields. They have a key role in generating a more competitive education environment and in increasing entrepreneurial individual skills in a lifelong learning context, especially on the higher education sector (Donnelly & Watkins, 2011; Fullan, 2007; Mama & Hennessy, 2013; Prestridge, 2014; Robertson, 2005). For this reason, different action strategies have been adopted in many countries to modify teacher education programs and more attention has been given to evaluate teachers not only through indicators such as years of teaching experience and number of students in the classroom, but also through teachers' level of knowledge and usage of ICT tools (Tezci, 2011).

This study focuses on the benefits that innovative teaching systems can generate for learning, especially with reference to distance teaching tools, the so-called smart teaching (Ambrose et al., 2010), with the aim of identifying the main contributions on the topic and summarizing their merits and defects, in the treatment of such a fashionable and interesting topic.

Teaching is evolving very rapidly and is proposing "deconstructed" forms that have almost nothing in common with traditional educational forms. For this reason, we consider it important to discuss a similar topic, which can offer an overall overview of the previous types of teaching and future trends on the topic. From structured education to deconstructed education, to who knows what new other forms.

The remainder of this chapter is structured in four sections. The second section offers a literature review of studies concerning ICT in education, providing an exhaustive description of its potentialities and criticalities. The third section describes and analyzes the relevant aspects of new teaching methodologies and their impact in the field of education. The fourth section examines how new ICT tools are changing the concept of learning and how they are redefining the role of teachers. The concluding section defines some relevant aspects on the relationship between educational strategies and methodologies and the use of ICT tools in education.

TECHNOLOGICAL INNOVATION FOR TEACHING METHODOLOGIES

What practitioners learn, as well as how they are taught, must keep pace with the changing environment. Technology and practice can be compared to a new understanding of learning theories and teaching methods in education. The student entering a profession from higher education today is most likely much more comfortable with the use of computers than an older student who has chosen a profession as a second career.

Many scholars argue that the use of computers and ICT tools support the improvement of students' curricula and creativity (Kivinen, Piiroinen, & Saikkonen, 2016). The implementation and adoption of new ICT methods will lead to further discovery of successful teaching strategies to keep pace with changes in the profession. Indeed, the advent of new technology has enabled a high degree of innovation, also in teaching methodologies. For example, the use of podcasting in the classroom or online courses, allowing to reduce/eliminate the geographic barriers representing hurdles to students living far away from educational sites (e.g., rural communities), guaranteeing access to continued learning by highly qualified educators.

An appropriate use of ICT in education can lead to the so-called "active learning" (Tinio, 2003): a new model of e-learning class employed in higher education, employing video lectures, computer-graded tests, and online discussion forums to enable free access in education to broader communities of students and improve the quality of higher education (Burd, Smith, & Reisman, 2015; Kim, Hannafin, & Bryan, 2007; Walker & Loch, 2014). Also, innovative computer-based materials can provide technical and practical training within the classroom, offering an alternative approach to the old one only available through many hours of "learning by doing" on the field (DeVoe, 2006; Valcke, 2004).

Many researchers (e.g., Banks & Banks, 2010; Mittler, 2012) in the field of ICT in education highlighted the relevance of ICT in supporting the development of policy plans to improve integration of ethnic minorities and disabled people, to design better educational reforms and to develop work–life balance for employees (Haddad & Jurich, 2002; Peeraer & Petegem, 2011; Sarkar, 2012). Aguilar and colleagues (2015) argued about the usefulness of "smart classroom" to combine teachers' experience with the use of 3D technology as a potential tool to create a smart and stimulating environment.

However, the potential benefit impact of ICT is not outright. Some authors (e.g., Fu, 2013; Sutherland et al., 2004) contend that a relevant gap does exist between the development of ICT tools and its use and integration in the education field. In this regard, the role of teachers is relevant, as one prominent question pertains to their resistance to change. In more detail, some authors (Livingstone, 2012; Pelgrum, 2001; Tondeur et al., 2006) argue that often teachers do not recognize the potential positive effect derived from the use of ICT tools in the classroom. For these reasons the use of ICT has still not deployed relevant results especially in the pedagogical and sociocultural teaching area. Additionally, there are some studies (Brush et al., 2001; Goktas, Yildirim, & Yildirim, 2008) arguing that there are many future teachers not satisfied with ICT integration in the classroom. To reduce this gap, in many countries ICT tools have also been used to increase the quality of teachers' training and their attitude to use them (Jimoyiannis & Komis, 2007; Tinio, 2003).

A critical role is also played by students' parents in the relationship between home and school, and in particular in creating the right conditions to students' usage of ICT tools (e.g., providing internet access for children at home) as a way to improve the opportunity of knowledge activities (Livingstone, 2012). Furthermore, in recent decades young peoples' engagement with new technologies has been regarded as a relevant support to create the conditions to transfer the learning activities from school to the home environment (Furlong & Davies, 2011).

The recent radical development of ICT has gone under the label "Artificial Intelligence" (AI), as a part of the computer science that analyzes the use of hardware and software systems to develop interactions that would seem to be the exclusive conduct of human intelligence. Artificial Intelligence can be used to contribute to the development of intelligent systems in smart classrooms and the co-creation of knowledge and scholarship in education. The development of AI in the field of education has led to the creation of a specific stream called "Artificial Intelligence in Education" (AIED), aiming at a more in-depth understanding and development of modern technologies in the educational field (McCalla, 2000). According to Baker (2000), a prominent feature of AIED research activities pertains to the use of computers to define different aspects of the educational area in which are present computational models. Artificial Intelligence, through the application of algorithms and software to the educational field, can support the recognition of strengths and weaknesses of each student with the possibilities to optimize their performance in various capacities, for instance, through the use of serious games and devices that use virtual and augmented reality to develop personalized learning activities. Additionally, the usefulness of AI has also been recognized in supporting teacher training and their continuous professional and skills development (Porayska-Pomsta, 2016), and in increasing students' educational knowledge through the application of the Intelligent Tutoring Systems (ITS; Brusilovsky, 2000; Rus, Niraula, & Banjade, 2015; Koedinger & Aleven, 2016; Self, 1999).

Finally, other researchers (e.g., Alimisis, 2013; Benitti, 2012; Yin & Moore, 1987) examined the use of robotics in the field of education. Educational robotics can improve some dynamic learning activities in the science and technology topics with the use of robots and coding making central the students in the educational process. In addition, robotics helps teachers manage classroom activities and monitor students' learning in the ILE—Intelligent Learning Environments. The ILE is a model of interaction between human and technology where people can use many intuitive interfaces. The intelligent environment includes the presence of computer networks, sensors, and mobile devices (Baker, 2000; Timms, 2016).

MODERN TEACHING FORMS AND APPROACHES

Since the 1990s, there has been a radical change in the way of experiencing the world that led to a metamorphosis in all areas. From then on, all teaching institutions started to exploit and to benefit from new educational technologies (de Gennaro, 2017). Indeed, there has been a progressive shift from the e-learning of the first generation, based on the use of closed platforms (called "Learning Management System"; Matuga, 2001), to the e-learning of the second generation, characterized by the use of devices of Web 2.0 and described as dynamic, interactive, democratic, social, and user-centered (John & Sutherland, 2004).

If until the early 2000s the "e-learning" expression has been the key term in the literature on distance education, in the following years new expressions have been imposed in the vocabulary related to the studies on web-based learning (Clark & Mayer, 2011). An example is the flipped lesson, where the teacher is no longer a mere "knowledge dispenser," but takes on a guiding and tutor role by providing students observations and significant considerations emerging through exercises, researches, and learning-by-doing re-elaborations (Bergmann & Sams, 2012; Tucker, 2012). The tool used in this type of teaching is above all the video—in the form of video-tutorial or video-lection—in addition to other multimedia resources, either created by the teacher him/herself or simply distributed by e-learning platforms.

Many schools are experiencing this path of methods renewal from a didactic for knowledge towards a didactic for skills, by placing themselves in the pedagogical area known as peer education (Shiner, 1999); for example, with the flipped classroom methodology new teaching strategies are adopted, the times and places of teaching and study are overturned and the students' active role in the learning process is constantly tested. Students are no longer simple "containers" of information: If with the previous methods the notions were transferred in a guided way by the teacher, using only the old style textbook, now the student interacts, proposes, and actively discusses.

The "overturned class" (Zhong, Song, & Jiao, 2013) allows students to also know the subject of the lessons through technology by reconsidering the usual alternation between lessons at school and homework. The video lesson seen at home allows teachers to concentrate him/herself on other aspects of teaching: In the classroom, there is more time available for group exercises, workshops, homework, case studies, and research, and moreover, the teachers have more time to follow the students with special educational needs.

Another example of new teaching methodologies is blended learning (Garrison & Kanuka, 2004; Graham, 2006), where technology becomes a key tool to improve teaching techniques at all levels. Blended learning is a training mode that involves two phases: (a) one of autonomous learning and (b) the other in the classroom with the teacher and the other students (Graham, 2006; Singh, 2003). Blended learning therefore combines the best of both methods of training: On the one hand, it allows the student to learn at his own pace, studying content even in an e-learning mode (perhaps from his mobile device); on the other hand it gives him/her the opportunity to confront him/herself with his peers and with the teacher, setting in motion a virtuous circle of continuous improvement (Garrison & Vaughan, 2008). Blended learning is an important form of training, especially when the supervision of the teacher is required for the complete training of a student (Rovai & Jordan, 2004). Most blended learning programs fall into one of the following four models (Chen, Wang, & Chen, 2014; Staker & Horn, 2012):

- *Rotational model:* A course or subject in which the students rotate (with a scheme that can be fixed or at the discretion of the teacher) among the learning modalities, at least one of which is online. Other modes may include activities such as small groups, project groups, individual tutoring, research. Students mainly learn at school, except for any homework;

- *Flex model:* A course or subject in which online learning is the backbone of learning, even if it also directs students to offline activities. Students move smoothly between learning modes. The teacher is present on-site, and students learn mainly at school, except for any homework. The teacher provides flexible face-to-face support through activities such as small groups, group projects, and individual tutoring;
- *Self–blend model:* A course or subject that a student follows entirely online to accompany other experiences that s/he is having at school or in a learning center. The teacher is online. Students can also participate in the course at school. Students take some "à la carte" courses and others face to face at school; and
- *Enriched-virtual model:* A course or subject in which students have requested face-to-face learning sessions with their teachers and then are free to complete their courses with online activities.

Furthermore, the adoption of information technologies (such as tablets or computers) even within many schools has given a strong acceleration towards an evolution of the school in a digital and more technological sense (Couse & Chen, 2010; Uzunboylu & Tugun, 2016). The technology, by itself, is not decisive in provoking change but it is certainly a factor enabling new practices, new methodologies and new forms of work that end up profoundly affecting the way and the spaces that define the scope of teaching and learning (Tugun, 2016). New "schooling" and training practices are facilitated by the pervasiveness of new technologies and by a new generation of digital natives who have developed new forms of relationship with technology in recent years, thanks to the Internet, social networks, and mobile devices (e.g., mobile phones, iPods, smartphones, game consoles, and tablets) and applications (de Gennaro, 2017). These phenomena have also ended up influencing the way in which people "do" school and relate to the knowledge, both from the point of view of the teacher (teaching and sources of knowledge) and the one of students (learning inside and outside the school).

Moreover, if before the new technologies the learning methods were reserved for a few categories of people, the new technologies offer, perhaps for the first time, to all students (those who, despite the crisis, still manage to be enrolled and attend school) powerful tools for the acquisition of knowledge and to do it in an interactive, social and collaborative way (Beldarrain, 2006; Goldin & Katz, 2018). Thanks to digital technologies and new mobile devices, the learning method of knowledge becomes more interactive (you look for what you need, click to collect useful information and always with a simple click you share it; Lindh & Nolin, 2016), through the use of new practices associated with the widespread connectivity and pervasiveness of mobile devices and technology (broadband connection, notebooks and tablets, video projectors, e-learning softwares; Mai, 2016), and all schools can more easily equip themselves with the technological infrastructure capable of supporting new forms of digital didactics and learning (Johnson et al., 2016).

Before continuing to talk about this educational revolution, the following box illustrates an example of innovative teaching methodology, namely "gamification."

BOX 1: THE GAMIFICATION

Gamification is a term that is gaining more and more popularity and that in a few years, it is expected, will be in common use in all marketing departments and beyond (Huang & Soman, 2013). But what is gamification? The term, as it is easy to guess, comes from the word "game," also associated with simple entertainment without any particular purpose. Gamification, however, is not just this, or at least not only: By taking advantage of the interactivity granted by modern means and of course the principles underlying the concept of entertainment itself, gamification is an extremely effective tool able to convey messages of various types, depending on the needs, and to induce active behaviors from the students/users, allowing to reach specific educational and teaching needs (Dicheva, Dichev, Agre, & Angelova, 2015; Kiryakova, Angelova, & Yordanova, 2014).

The user and his active involvement must always be at the center of this approach. Typical objectives normally achieved thanks to the use of gamification for business are for example the improvement of customer management, the consolidation of loyalty to a brand, or even the improvement of performance by employees and partners (Caponetto, Earp, & Ott, 2014).

The video game market has grown strongly in recent years, with numbers that continue to grow without signs of slowing down, especially as a function of profits. The video game is now a huge industry, able to create products for multiple platforms, from consoles dedicated to mobile phones to home TVs. Gamification can be defined as a set of rules borrowed from this world of video games, which have the objective of applying game mechanics to activities that do not directly have to do with the game; this way it is possible to influence and modify people's behavior, favoring the birth and consolidation of active interest by the users involved in the message that has been chosen to communicate, whether this is related to the increase in personal performance or more specifically to educational performance (Dicheva et al., 2015; Lee & Hammer, 2011).

To achieve these objectives, the educational and teaching design process must necessarily be rethought in order to introduce mechanics and game dynamics, adding to the traditional factors other driving components (again, borrowed from the "gaming" world) that can attract the interest of students, pushing them to return to specific content voluntarily and repeatedly proposed over time (de Sousa Borges, Durelli, Reis, & Isotani, 2014). The mechanics and the dynamics of the game represent the real "tools of the trade" within the gamification, necessary to "gamify" a site or a service: The introduction of concepts such as points, levels, missions, and challenges encourages students to invest their time, pushing them to participate and helping them build relationships within the game (Nah, Zeng, Telaprolu, Ayyappa, & Eschenbrenner, 2014). These relationships motivate students to achieve predetermined objectives (e.g., improving their skills, increasing knowledge, etc.) by modifying their behavior (Stott & Neustaedter, 2013).

Albert Einstein claimed that the game is the highest form of investigation. Gamification is therefore a strategy by which ordinary processes are infused with the principles of motivation and commitment inspired by game theory (Smith-Robbins, 2011). Games have always been popular throughout history and their dissemination has been facilitated by the advent of the Internet and the birth of social networking. Given that the games attract the attention of many people, especially in virtual environments, since teaching must not always and necessarily take place in a formal classroom context and it can also take place in informal settings, in general, any formal or informal situation in which information is exchanged with one or more persons provides for the existence of an "educational mediator" (Hanus & Fox, 2015). The presence of this figure makes the discussion interactive, as people can ask questions and receive answers in real time.

Even learning based on technological tools can take place in a completely informal context. In fact, when a child uses some iPad apps, he can learn the alphabet, the tables, the songs, and so forth (Falloon, 2013), while the older students, on the other hand, learn different things by watching videos on YouTube (Tan, 2013) or browsing from one site to another that deals with a particular topic. The advantage of computer-based training stems from the fact that content can be used at any time of the day, but it does not allow the student to ask questions for any clarification.

Games, by eliminating gender differences and various technological complexities, share four characteristics that are: goals, rules, feedback system, and voluntary participation in the challenge (Larsen, Schou, Lund, & Langberg, 2013). Gamification, therefore, in its most rigorous form, is the application in an educational context of everything that is the prerogative of games, such as points, levels, rankings, and badges (Su & Cheng, 2015). This new way of teaching encourages the increase of interactivity, due to the reward mechanism that pushes the student to reach a well-defined a priori goals; moreover, the level of awareness of what is being done increases, as students are faced with scenarios of a practical nature which, generally, are not proposed during traditional teaching activities (Hamari, Koivisto, & Sarsa, 2014; Kapp, 2012).

THE REVOLUTION OF EDUCATION

The place where the training and education of new generations takes place and the learning of knowledge, is today obliged to radically rethink itself—reorganizing methods and teaching practices to take into account the enabling available technology, but above all human resources (students, young people, etc.) with a different head (mindset but also brain) because they have grown up before and outside the school (Kennedy, Judd, Churchward, Gray, & Krause, 2008; Margaryan, Littlejohn, & Vojt, 2011). Indeed, the mindset of students, and some (perhaps many) teachers has changed because their way of accessing knowledge has changed (Bennett & Maton, 2010).

New technologies, pervasive in peoples' personal, social, and work life, can no longer be kept away from school (De Vries, 2018).

Access is no longer linked to physical places such as schools, but to virtual spaces (e.g., the Internet, web, online communities, social networks, etc.) that facilitate individual research and the acquisition of new knowledge and allow this to be done with, and thanks to, the collaboration of others; indeed, if studying is the primary learning tool, the teacher's role is bound to change (Beldarrain, 2006; Weigel, 2002) from a knowledge transmitter (frontal teaching) to an interlocutor able to suggest, bring out, and direct new research logics and research methods of new knowledge on specific and always interdisciplinary themes (Collins & Halverson, 2018).

Furthermore, the introduction of tablet devices in the classroom has changed the teaching context and favors, visually and organizationally, the transition from a classroom divided between students' chair and desks, to a more functional one, made up of one or more teams working in teams, in collaborative islands and cooperative training and learning teams (Ditzler, Hong, & Strudler, 2016; Domingo & Garganté, 2016). The group work, carried out in the classroom through the use of tablets and other devices, can also continue outside the school in a virtual classroom that is realized through the spaces of the network, its connectivity and its social and interactive collaboration tools (Wang, Tchounikine, & Quignard, 2018). The new interactive classrooms (islands) are functional to the new learning practices of generations that have grown up on the web that have not developed, like the previous generations that grew up on the printed book and in the inception, the mnemonic learning but the "by searching" one (Liu & McFerrin, 2008; Rieh, Gwizdka, Freund, & Collins-Thompson, 2014).

Learning made with the search engine, knowledge shared online (e.g., Wikipedia), exploration of new knowledge through links, references, and online links, simulations and digital experiences (e.g., Second Life): The new forms of learning benefit from individual creativity and from the shared contribution of knowledge, talent, and experience that each member of the team (virtual classroom) carries around but also obliges a constant remodeling of (virtual) spaces and forms of learning (Dreher, Reiners, Dreher, & Dreher, 2009; Rennie & Morrison, 2013; Selwyn, 2012). Group learning by searching also remodels the knowledge of each participant in the collective social experience by changing opinions and points of view and by fostering a mental elasticity that favors the emergence of new knowledge and new competencies (Pai, Sears, & Maeda, 2015).

In this new context, the role of the teacher also changes (Putnam & Borko, 2000), called to guide people already experienced in the search for new knowledge but still uncertain about the methods to be used and the approaches to be taken to solve problems and acquire new skills and talents (Baylor & Ritchie, 2002; Ertmer & Ottenbreit-Leftwich, 2010). The teacher must be the facilitators and guide in indicating new ways of evaluating the results that take into account the group discussions but also the sources of online knowledge used and the way in which new knowledge is made public and shared (Hughes, 2005; Wheeler, 2001).

What makes the difference compared to the past are the availability and the specificity of the new technologies that can be used in schools, but above all the fact that the analog classroom is increasingly online and virtual (Bayne, 2008). The new virtual teaching context affects the forms of learning that become increasingly collaborative and encourage the sharing of knowledge and the opening of new horizons of future development of teaching both at school and after/outside the same (Aldrich, 2009). The new horizons are made possible by a great availability of concepts and information thanks to the network and the new mobile devices, to the quickest and fastest sharing of knowledge, to the traceability of the knowledge found and produced by group research, to greater visibility of content and of the results produced, to the greater creativity and participation induced by the new forms and didactic methodologies, and to the possibility of documenting the whole evolution and research and work phase of the group (Bonk & Cunningham, 2012; Christensen, Johnson, & Horn, 2010).

The new technologies introduce many benefits and advantages such as the ease with which it is possible to communicate the results obtained and the work produced by the group work in the (real/virtual) classroom and the construction of a group historical memory useful for future activities and for a critical and dynamic reinterpretation of the results obtained (Denton, 2012).

The new forms of teaching and learning obligate the teacher also to change methods for evaluating the work of the learner (Parkay, Stanford, & Gougeon, 2010). The new contexts offer the teacher the possibility of using different criteria for evaluating a higher value than their traditional use: These criteria are the commitment put into group activity, the creativity expressed (the creative process is not indifferent to the tools that have been used), the capacity for ideation and proposition, collaboration, the ability to design, the capacity to argue, dialogue and communicate, the dialectic capacity and even leadership and/or public exposure capacity (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Palak & Walls, 2009; Tondeur et al., 2012).

CONCLUSIONS

In recent years the technological development, the diffusion of mobile and fixed devices, and the connection to the web network, allow to structure new forms of deconstructed teaching and new learning environments in which students and teachers interact with tablets, netbooks, or smartphones. Co-constructive and cooperative teaching, through apps to be used as learning environments or tools, overcome the frontal approach of the lesson and encourage more active teaching. The same members of the working groups are called to participate in the evaluation in order to engage in group practice the habit of cooperative and collaborative work, intellectual honesty that favors the public sharing of new ideas and opinions, and the acceptance of the reasons of the others and different and opposing points of view (Hrastinski, 2009; Judd, Kennedy, & Cropper, 2010).

A rational use of digital technologies in teaching must start from an assumption: It is not teaching that must adapt to technology, but it is technology that must be used and adapted to make teaching more effective. This presupposes clarity on the educational aims, on the learning objectives, on the most useful strategies and methodologies to achieve the objectives and, lastly, on knowledge and mastery of the technologies that could serve to better achieve the educational goals.

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CHAPTER 9

EDUCATING BUSINESS STUDENTS FOR THE AGE OF INTELLIGENT MACHINES

A Framework for Online AI-Enabled Learning

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ABSTRACT

We propose an online learning framework that uses artificial intelligence (AI) modules to facilitate experiential learning and prepare business students to compete in a world increasingly dominated by intelligent machines. In doing so we utilize examples of AI adoption and usage as they apply to online teach-

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ing and learning, focusing on collaborative human AI problem-solving. The framework incorporates experienced instructor judgement to mediate the learning relationship between the student and various AI tools. We argue that the nature of the specific skills developed in the student reflect the emerging human–machine partnership required to solve real-world problems and make better informed decisions. This in turn requires the student to understand the capabilities and knowledge of the AI system, the potential contribution of the AI system in solving the problem at hand, and (ultimately) the role of the student in collaborating with the AI system. We illustrate this by describing a detailed case within the learning context of an auditing task, which is emblematic of a class of business problems that require professional judgment and decision making to evaluate the quality of a process or system.

INTRODUCTION AND MOTIVATION

It is widely recognized that intelligent machines in the form of AI are poised to fundamentally and permanently change the nature of work. Few professions are insulated from this impact, including those "white collar" occupations that historically have required a high level of education. However, within these professions the impact of AI is expected to vary widely. The question of why the risk of automation differs so dramatically across and even within professions can be answered by examining the activities comprising the profession and the specific skills utilized. A recent McKinsey report suggests that the key to understanding the susceptibility of a profession to AI is in recognizing the activities required by humans to perform effectively in that profession (Chui, Manyika, & Miremadi, 2016).

Professions that are less susceptible to automation typically involve the application of judgment skills (Agrawal, Gans, & Goldfarb, 2017). For example, professions such as lawyers and paralegals, generally speaking, are significantly less susceptible to automation than others. In that profession, the requirement for seasoned judgment generally insulates the highest-level practitioners—attorneys and paralegals—from displacement by machines. However, we acknowledge that even in the legal profession different specialties are differentially susceptible to automation depending on the level of judgment. For example, jobs within the legal profession that can be done more quickly and accurately (i.e., contract and patent work) by algorithms are far more susceptible to AI displacement than those where judgment and communication are more essential (Frey & Osborne, 2017).

On the other hand, the accounting profession, long considered to be a stable and secure career, appears to be highly susceptible to AI displacement, with a "probability of automation" predicted to be approximately 94% (Frey & Osborne, 2017). This is because many tasks within accounting are routine, and are reliant on accuracy, precision, and efficiency—precisely the skills for which machines possess superiority. Nevertheless, like the legal profession, the aspects of accounting that are more reliant on judgement are significantly less vulnerable to automation.

Therefore, new approaches are required to prepare college graduates to survive and thrive as AI becomes pervasive in virtually every profession. Some have suggested that machines are "winning the war" against humans, but we consider that to be, at best, an inaccurate representation of the situation. The question is how we can educate students to work with intelligent machines, rather than compete against those machines. The answer clearly lies in understanding the relative strengths and weaknesses of humans and machines, and how they can complement each other in a problem-solving and decision-making partnership. Therefore, in this chapter we propose an online learning framework for building student-AI collaboration skills.

An online learning environment is particularly promising for AI integration for several important pedagogical reasons:

- The context is far less reliant on a human in a face-to-face setting, so an online approach can establish an "experiential" learning environment within which students interact with an assortment of AI systems in a variety of problem domains. Essentially, it offers a platform for machines to teach students skills including how to interact most effectively with AI.
- In an online course, student-to-student interaction is limited because the interaction is with (or at least through) the computer. However, that is advantageous if students are learning the skills necessary to communicate with intelligent computers directly.
- An appropriately enabled online system can provide a simulated problem-solving discourse between the student and an AI, allowing students to learn partnering skills directly from the very intelligent machines with which they will be interacting throughout their careers.
- As noted in the Framework section (below), an online learning environment supports most closely the concept of "next generation digital learning environment."
- It offers students the best opportunity to master digital fluency, which is the ability to leverage technology to create new knowledge and develop critical thinking and problem-solving skills (Sparrow, 2018).
- Online learning is inherently cloud based, which is consistent with the manner in which businesses are consuming deep learning through the integration of AI and other emerging business applications (Walker, Andrews, & Cearley, 2018).
- Perhaps the most important reason of all—the fact that online courses are well suited to support the general movement in higher education toward a model that emphasizes learners (students) more than teachers (instructors).

THE POTENTIAL FOR HUMAN–AI COLLABORATION

Human and intelligent machines have different strengths and weaknesses. For example, machines are good at data identification and extraction, determining patterns from large amounts of data, prediction, classification, recommendation, induction, speed, accuracy, stamina, availability, reliability, and consistency—all things that humans are far less capable of. Conversely, humans are good at exercising judgment, communicating, general reasoning, persuasion, creativity, dealing with ambiguity, managing complexity, emotional intelligence, empathy, understanding, providing context (e.g., dealing with a date set that is incomplete or contains certain errors), flexibility, adaptability, skepticism, and dealing with novel situations (Nizri, 2017). Those skills are not the hallmark of even the most intelligent machines.

Fortunately, those skills are almost perfectly complementary, and therefore provide the potential for fruitful collaboration between humans and machines to solve problems and make decisions that neither can accomplish independently, at least to an optimum outcome. Potentially, machines can handle repetitive tasks that can be characterized within algorithms, while humans can assume responsibility for providing oversight, understanding the context, and making appropriate holistic decisions that might or might not coincide with the reasoning of the machine. For example, Ransbotham discusses the case of Stanislav Petrov, a Soviet-era military officer who essentially prevented a nuclear war between the USSR and USA by overriding an automated system's interpretation that intercontinental ballistic missiles from the United States had been launched against the (former) USSR (Ransbotham, 2017). Reasoning beyond the narrow context of the data, Colonel Petrov concluded that the broader picture indicated that a missile strike under the circumstances was highly unlikely and therefore overrode the system's recommendation for a counterstrike. The human race is indebted to the Colonel for exercising his judgment at great personal and national risk.

The example above suggests that the best scenarios can occur when humans collaborate with modern AI systems in professional settings so that each "party" contributes its own skills and knowledge to the problem at hand, while compensating for weaknesses in the other. For example, Knight noted that while physicians were shown to be better at cancer diagnosis than an AI system, the collaboration between physician and machine performed even better (Knight, 2017). In a business setting, Accenture's Wilson and Daugherty (2018) characterize human–machine collaboration and specific roles for both humans and machines in two essential contexts: (a) "humans assisting machines" and (b) "machines assisting humans."

Wilson and Daugherty present a set of three roles and their associated general skills and knowledge that encompass the complementarity that is ideal in human–machine collaboration. The first two of those roles, *explainer* and *sustainer*, are best performed by humans. Humans can "assist" machines by *explaining* the often opaque reasoning process through which an AI system makes conclusions. The example cited by Wilson and Daugherty describes the need for a human to understand and explain the rationale for a legal sentencing or medical recommendation from an AI system. Humans can also assist machines in a *sustainer* role by ensuring that an AI system is functioning appropriately (i.e., properly, safely, and ethically), as Colonel Petrov did in the case cited above. In a traditional business setting, Wilson and Daugherty note the need to oversee an AI credit approval system that might discriminate against certain groups, or to ensure that the data used by an AI system is compliant with legal and regulatory requirements such as the European General Data Protection Regulation (GDPR). The third role, *amplifier*, is more appropriately the domain of intelligent machines. Wilson and Daugherty indicate that machines can assist humans by serving as cognitive amplifiers of the human's inherent analytical and decision capabilities, thereby in essence multiplying humans' abilities (Wilson & Daugherty, 2018).

TEACHING ARTIFICIAL INTELLIGENCE COLLABORATION SKILLS IN AN ONLINE ENVIRONMENT

Given critical trends in the professional workplace and the potential of human–AI collaboration, it is incumbent upon educators to recognize opportunities and to determine how to prepare students accordingly. Online learning provides an especially appropriate mechanism to facilitate students' learning how to work with AI, provided instructors and course designers understand and embed experiences and activities that enable students to develop the ability to engage actively in that collaboration. To exploit that mechanism, however, a new online learning framework is required. Such a framework recognizes the need for students to develop specialized technical ("hard") and interpersonal ("soft") skills tailored to the specific capabilities of different AI systems. That requires students to develop deep insight into what AI can and cannot do from a technical perspective.

The evolving capabilities of modern, cloud-based learning management systems lend themselves to this type of learning framework. Brown, Dehoney, and Millichap (2015) note in particular that online systems facilitate the broader trend of higher education "moving away from its traditional emphasis on the instructor . . . replacing this emphasis with a focus on learning and the learner" (p. 42). They also argue that higher education is "moving away from a standard form factor for the course, experimenting with a variety of course models" (p. 42). In particular is their prediction that emerging learning management systems will be based on a "new digital architecture" characterized by a variety of "new learning components" (p. 42).

This component model is key to an online approach that enables AI–machine collaboration-skill learning. Specifically, so-called Next Generation Digital Learning Environments (NGDLE) would coordinate a set, or "confederation," of systems and application components that adhere to common standards (Brown et al., 2015). Brown et al. (2015) note that these systems would include "content repositories, analytics engines, and a wide variety of applications and digital services" (p. 43). The NGDLE in turn would enforce standards to ensure interoperability, including data and content exchange, between and among the components in the confederation. The NGDLE would also focus on personalization and collaboration, the latter being of particular interest because collaboration is fundamental to many forms of learning.

THE FRAMEWORK

We provide a simplified framework and example to illustrate how AI-embedded online learning can help students develop their ability to collaborate effectively with machines. We selected the field of accounting as the platform for our example for the following reasons:

1. As we mentioned earlier, this profession is considered highly at risk of automation displacing humans.
2. Accounting tasks exhibit a number of opportunities for humans to collaborate with an AI system.
3. Accountants are increasingly required to have reasonably in-depth knowledge of IT systems; therefore, accounting students need to become comfortable interacting with technology, including advanced technologies such as AI.

Table 9.1 provides an overview of the learning environment within which human–AI collaboration knowledge is instilled in students. The table begins, in the left column, by establishing a learning context from Simon's general reasoning capabilities that managers are expected to exercise (Simon, 1977). From this basis it identifies the applicable human and machine roles (from Wilson and Daugherty, discussed above) and corresponding skills that are important for students to develop in order to collaborate with intelligent machines. Finally, the table lists a spectrum of typical problems/cases that accountants, in particular, need to master.

TABLE 9.1 A Framework for Teaching Human–AI Collaboration

Choice-Decision Process	Human Role and General Knowledge	Machine Role and Specialized Skill	Problems/Cases
Development of general reasoning capabilities (Simon, 1977): 1. *Intelligence* – Situation assessment: Analyze the case. Research the applications. 2. *Design* – Align/Match the capabilities of the AI applications to their potential role in solving the case. 3. Choice: – Choose the applications that are most appropriate for solving the case.	Explainer • Communication • Understanding and providing context • Judgement • Empathy Sustainer • Understanding and providing context • Judgement • Empathy • Skepticism • Validation • Interpretation • Ethical, legal knowledge • Policy and Professional standards knowledge	Amplifier • Data identification and extraction • Pattern Recognition • Analysis • Prediction • Classification • Generation of Choices • Recommendation • Induction • Speed • Accuracy • Availability • Consistency	• Auditing and Attestation • Bookkeeping/General Ledger • Inventory • Forecasting • Financial Trend Analysis • Tax preparation (analysis and reporting) • Accounts payables/receivables • Financial Accounting and Reporting (e.g., GAAP) • Financial Statement Preparation • Financial Statement Analysis • Regulations and Compliance • Ethics and Legal Standards • Contracts • Consulting • Payroll • Banking

General Reasoning Capabilities

A notable advantage of this experiential approach is to put the responsibility for learning squarely on the students. There is a general reasoning process in which students must engage before they even begin to interact with an AI system. Referring to Table 9.1 and following the logic of Herbert A. Simon (1977), students must first exercise *intelligence* when presented with the problem/case. Intelligence alerts students that a problem exists and that action needs to occur. That action will be in the form of a decision or a change. Students will need to perform a situation assessment to analyze the problem/case, research available applications, and determine the benefits of alternative AI tools that can be used. Students must then *design* possible solutions to the problem/case. That requires them to match the capabilities of possible AI tools to the problem that they confront, and to formulate possible courses of action in response to the situation in a way that can achieve their desired outcome—solving a problem or addressing a case. Finally, students must make a *choice* from among the possible design alternatives, selecting the one that will most effectively and efficiently accomplish their goal. Simon's logic suggests that these three general reasoning activities are interdependent, and we view them accordingly as the elements of a process that will result in students' selection of an appropriate AI application. We acknowledge that students are also likely to take an iterative trial-and-error approach unless instructors place an AI application right in front of them—which would miss the point entirely. However, with experience, students will recognize the inherent disadvantages of simply selecting an AI tool from a set without proceeding through the general reasoning process, and instructors can be instrumental in reinforcing that discipline. We cannot overemphasize the importance of the choice-design process being an integral consideration during course design.

Human and Machine Roles

Accounting instructors can select challenging problems/cases for students to solve according to the specific learning objectives of each accounting course. In preparing the course, instructors would also choose AI applications that are potentially applicable to solve those problems. By explicitly indicating the specific roles and learning objectives required of the student, Table 9.1 provides guidance to the instructor by coordinating the types of problems/cases to present to the student based on a desired learning outcome or outcomes. Utilizing Table 9.1 like a dashboard, the instructor can choose roles and associated skills, and then pair the student with a case that has been classified or "tagged" with those roles/skills. For example, a particular student could be assigned the objective of assuming the role of explainer in an auditing task, which requires skills such as judgment, understanding context, and communication. This in turn could lead the instructor, or perhaps even the student him/herself, to select a case that requires that particular role and set of skills. In the following section we provide a case example that demonstrates this pairing of an accounting problem, the expected role of the student, and the skills required to perform that role.

CASE EXAMPLE—AUDITING

There is a class of business tasks that require professional judgment to evaluate the quality of a process or system. Financial statement auditing is one such task. Publicly held organizations are required to engage an independent certified public accountant to evaluate and express an opinion on the quality of the financial statements produced by the organization's accounting system. The financial statements summarize accounting data which represent facts about the organization's business transactions for a particular period. To form an opinion, an auditor evaluates the extent of correspondence between the accounting data and the events that they describe.

Auditing standards require an auditor to "plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether caused by error or fraud" (Public Company Accounting Oversight Board, 2017, p. 4). There are many types of evidence that auditors collect: They observe processes, count assets, confirm balances with banks, customers, and vendors, recalculate amounts, and compare source documents. Traditionally, auditors examine only a sample of transactions. The reasons why they sample include their own cognitive limitations as well as time and other resource constraints. The nature and extent of the sample is dependent on the auditor's assessment of the risk of misstatement, which is based on industry factors, current economic conditions, inherent risk of fraud or error related to specific types of transactions, and firm specific policies and procedures, including the organization's control procedures to prevent or detect and correct errors in the accounting data. In planning and performing the tests, auditors draw on expert knowledge of known fraud schemes and typical errors, and how those types of transactions might appear in the accounting data.

Recent widespread adoption of enterprise resource planning (ERP) systems and the availability of accounting specific data extraction and analysis software tools such as ACL™ Analytics and CourseWare Analytics IDEA® allows auditors to examine and test a client's entire population of accounting data. Auditors can search specifically for all transactions that fit a profile of erroneous or fraudulent transactions (e.g., duplicates, gaps in sequences of transaction numbers, reversing journal entries) or transactions that are statistical outliers (e.g., amounts more than three standard deviations from the mean). Applying such tools to the entire population of transactions may flag many transactions, including many false positives. The challenge is choosing which error and fraud schemes to test for and combining the results of multiple tests so that the auditor can spend his/her time investigating the highest risk transactions—in other words, those that require in-depth examination and the exercise of careful reasoning.

The application that we present in the example that follows is MindBridge Ai Auditor, a cloud-based AI auditing application developed by MindBridge Analytics Inc.™ The company describes Ai Auditor as "the world's first and only AI powered auditing platform." It is designed to detect accounting irregularities caused by human error and fraud which accountants find challenging. According to the company, Ai Auditor is used by numerous CPA firms across six countries to assist in performing external audits of their clients. Additionally, the company's clients include many business enterprises and government agencies that use Ai Auditor to support their internal audit operations (Celeski, personal communication, September 20, 2018).

The Ai Auditor application is an expert system that analyzes every transaction, rather than sampling accounts as auditors do, to determine where the higher risks are. MindBridge Ai Auditor uses expert-derived, rule-based knowledge as well as machine learning; thus, it represents a hybrid approach that employs multiple techniques including domain expertise with accounting rules, statistical methods, and machine learning to detect patterns of irregularities. The application allows auditors to import clients' data and compares every transaction to every other transaction to understand what are common practices for a client versus what are not; in essence, through machine learning MindBridge Ai Auditor "calibrates" itself to a given client to discover what is normal and what stands out as unusual. It then calculates a risk score for every transaction and presents results on a dashboard. By "flagging" those transactions with the highest risk, it focuses the auditor's attention to where the most unusual transactions are. The auditor must still use professional judgment to confirm the risk assessment and to select flagged transactions for further investigation. In summary, Ai Auditor does the "heavy lifting" of auditing in the background, augmenting the capabilities of its users by identifying which transactions represent a higher degree of risk and warrant further investigation. By analyzing and scoring 100% of a client's transactions, Ai Auditor frees professional auditors to use their accounting and industry knowledge, judgment, experience, and insights to review results, consider them in context, and draw correct conclusions.

MindBridge offers a University Alliance program that provides schools with access to a full version of the Ai Auditor software (limited only by the number of files that can be analyzed), a set of case scenarios with data sets and solutions for each, a demo case accompanied by step-by-step instructions, and some suggestions for integrating the cases into a course. To date over 35 universities have signed on to that program (Celeski, personal communication, September 20, 2018). MindBridge also has a repository for faculty to share additional materials and resources. On-demand webinars and videos that provide background and demonstrate some of the features of the Ai Auditor software can be found on the company's website. Ai Auditor itself is user-friendly and requires limited technical knowledge to use, and students can familiarize themselves with the system's functionality and capabilities in under 2 hours.

Ai Auditor is appropriate for incorporating in an auditing course, a fraud examination course, or a data analytics course at the undergraduate or graduate level. Students should understand the auditing process and have knowledge of common fraud schemes and tests of transactions performed by auditors to detect those schemes as well as inadvertent errors. An auditing assignment on discovering and investigating fraud can be delivered as a module in an online course asynchronously to allow students the flexibility to perform the exercise according to their own schedules without having to wait for others to complete aspects of the exercise in unison.

Learning Objectives

For an auditing course, a set of suggested learning objectives might include:

- Discuss the functionality of AI software and how it supports auditing.
- Describe the part of the auditing task to be performed by AI.
- Compare and contrast the way auditing is performed with and without AI.
- Identify the roles of AI and human accountants in the auditing process.
- Explain the importance of human judgment that remains after AI has performed its task in the auditing process.

The first two objectives require students to know the role of the intelligent machine in the context of the auditing task. The third and fourth objectives require students to discern between the roles most appropriate for AI and humans. The final objective requires students to recognize the limitations of AI and the important role of human judgment in critically evaluating what the AI presents to them.

Referring to Table 9.1 clarifies the knowledge and skills developed when students partner with AI in the online learning environment. For example, students perform the role of *explainer* through their understanding of AI functionality and the context for its use, and they perform the role of *sustainer* when they exercise judgment, skepticism, interpretation, and validation of the AI-produced results, with due consideration for the ethics and professional standards of the accounting profession. Artificial Intelligence performs the role of *amplifier* in a comprehensive way through data extraction, pattern recognition, analysis, prediction, speed, accuracy, and consistency.

Activity—Background, Tutorial, and Demo Case

MindBridge provides a demonstration case for students to learn how to investigate financial statement fraud in the form of concealed liabilities and expenses using Ai Auditor. We will use that case to illustrate how an AI application can provide a realistic, effective, and efficient experiential learning method. Specifically, that case involves executive manipulation of the general ledger to improve a fictitious company's bottom line so that it meets key performance indicators to justify a bonus to the CEO.

Background

Instructors should assign students to read the article "How Artificial Intelligence is Changing Accounting" in the *Journal of Accountancy* (Ovaska-Few, 2017), as well as other selected articles (or articles discovered by the students themselves) about the strengths and limitations of machine learning and its application to the field of accounting. Students would then be directed to watch an AI Auditor overview video (MindBridge Analytics, 2019) to become familiar with the functionality of the system.

Before introducing an AI tool in a course, students must have sufficient background knowledge of the task, including the inputs, processes, and expected output. The instructor must evaluate the knowledge, skills, and abilities of the student audience and provide resources or assignments to develop the base level required to understand and complete the task. We assume that the audience is accounting students who have knowledge of the auditing process, common fraud schemes, and common data analytic tests of transaction data. We also assume they do not have sufficient knowledge of AI, machine learning, or how AI is being adopted in accounting firms. Accordingly, the background portion of the activity focuses on enabling students to develop the necessary skills and knowledge to understand the problems that accountants face and the opportunities for them to use AI.

In designing this activity, we considered the learning objectives and the questions the students will have to answer at the end of the exercise. Part of this is instructor-directed, and part of it is discovery-based learning. That is, the student must search for and identify useful sources. The *instructor-directed* component ensures that certain key information is available to students. The article from the *Journal of Accountancy* (the professional journal of the American Institute of Certified Public Accountants with an audience consisting of practicing CPAs) discusses how AI is changing the profession. The on-demand webinar from MindBridge explains how and why the Ai Auditor tool is used. It provides screen shots of the software as it is being used. That video provides information that will be useful when students have to explain how and why they used that tool. The *discovery-based* component requires students to look for articles about machine learning to understand, among other concepts, clustering vs. classification—which are two approaches to machine learning. They are also assigned to search for and read information about the strengths and limitations of machine learning, which they can integrate to expand their base knowledge of the task, understand more deeply how AI software functions, and reason about its relevance to the assignment.

Tutorial

Students then complete a self-directed tutorial that familiarizes them with Ai Auditor. The tutorial guides students through a systematic process to identify transactions of interest, and it consists of three sections, each having a set of specific learning objectives appearing below:

Section 1: Preparation

- Logging in, creating a client organization, and creating an engagement
- Inviting peers to collaborate on an engagement (if that option is approved by the instructor)
- Learning about the account mapping process and why it is important
- Learning about various control point indicators and how they can impact risk score calculation and search functionality

The preparation phase of the tutorial lets students create a client, an engagement, and select the type of analysis that they wish to perform—in this case, a general ledger analysis. Students then upload the general ledger and review a selected set of control points. Although they can change the control point weightings if required, for the purposes of this tutorial students are advised against changing them because they were chosen carefully to support the demonstration. Students then use Ai Auditor to calculate risk scores in the general ledger module based on control point indicators. Ai Auditor performs the risk analysis and calculates a risk score (0–100%) for each transaction based on the number of control point indicators that a transaction fails.

Section 2: Analyze the Journal and Create Tasks

- Understanding the risk overview dashboard
- Understanding the data table and how to explore specific transactions
- Understanding how to use the smart search functionality to identify transactions of audit interest
- Understanding how to create tasks for further investigation

The analytics phase of the tutorial teaches students how to use the various investigative features in Ai Auditor and how to create tasks to export for further investigation based on their risk. A "dashboard" presents three "risk buckets": high, medium, and low, with risk scores above 50%, 30–50%, and below 30%, respectively. That quick presentation of transactions from the general ledger highlights those that are the most anomalous and provides the opportunity for students to select the various risk buckets for detailed investigation. Because auditors would be most interested in high-risk transactions, students should focus their attention to selecting those transactions and to creating tasks to export them for investigation. All of the tasks that they create will be listed in an audit plan.

Section 3: Export an Audit Plan

- Accessing the audit plan and reviewing the created tasks
- Exporting the audit plan

The final phase of the tutorial instructs students how to view the audit plan and export it into a spreadsheet that will contain all information that is required for audit documentation.

Demo Case

A demo case represents the applied experiential portion of the auditing assignment. After they have completed the Ai Auditor tutorial, students work on the assigned demo case at their own pace. That assignment would require them to use Ai Auditor to analyze the case data as follows:

1. Submit a list of changes they made to the Ai Auditor configuration with explanations.

2. Prepare an audit plan with an explanation for each transaction selected for follow-up.

The demo case walks students through the sequence of steps using the Ai Auditor and explains the reasoning behind the configuration and audit plan choices made. Those choices are context dependent, so the reasoning must relate audit process knowledge and fraud scheme knowledge with case-specific facts. The first step in auditing a company is to gain an understanding of its industry and its business policies and procedures. The demo case provides the following scenario for the fraud case study involving a fictitious company and its general ledger:

> Builder Inc. is an innovative construction company located in Western Canada. It employs a staff of 150 and is relatively successful. Even though the company has experienced steady growth in recent years, competition is fierce and margins are shrinking. A significant portion of the CEO's pay (Steve Smith) is profit related. During audit planning this risk is identified and appropriate audit procedures are to be planned and executed to address this risk . . . It is also important to note that bookkeeping is regularly done on weekends.

Students must analyze the general ledger using the appropriate MindBridge tool that addresses the fraud risk, identify no more than 20 transactions using the various investigative features in Ai Auditor, create "tasks" for those transactions, and export them in the form of an audit plan.

The first decision students must make is how to configure the software. The nature and extent of audit tests is dependent on the auditor's assessment of the risk of material misstatement in the financial statements based, in part, on company-specific information, industry information, and general economic conditions. To reiterate, Ai Auditor analyzes the client data using a variety of tests (control points), including tests designed to detect common types of fraud or errors. It combines the results of all of the tests into a composite risk score by assigning weights to each test beginning with default values for the weights. The auditor (student) configures the software to the client scenario by adjusting settings related to materiality (dollar amount of transactions) and to the weights assigned to various tests used to calculate that overall risk score. The software also includes a list of key words associated with errors and frauds. For example, journal entries with the words "adjust" or "reverse" are flagged. The list of key words can be edited by students during the configuration step. This is the *design* phase of the project.

Based on analyses and profiles of previous fraud cases, auditors have identified "red flags" that are associated with certain fraud schemes. The case scenario provided to the students includes some cues or red flags: highly competitive market, steady growth but shrinking margins, and CEO pay that is tied significantly to profit. Those facts point to higher risk of fraud techniques to conceal liabilities and expenses.

Students must interpret the facts of the case and reason deductively about how to adjust the weights and key word list. For example, one test checks whether a transaction was posted on a weekend. Many times fraudulent transactions are entered on weekends or after hours when fraudsters have the time and privacy necessary to do so. In the demo case, the client regularly performed bookkeeping tasks on weekends. In that situation, the auditor (student) should set the weight for the weekend posting test to zero. Similarly, because the auditor should be concerned about the CEO trying to increase profitability, s/he could adjust the software to rate journal entries with the CEO's name to be weighted higher.

After the settings have been configured, Ai Auditor analyzes the data. It produces results in a number of ways. First, it creates three "risk buckets." Based on the analysis, transactions are assigned a composite risk score and are placed in a high risk, medium risk, or low risk bucket. The auditor can drill down into each transaction to see the factors that affected that transaction's score. The software also provides several other ways of visualizing the results. It is important that the software does not identify fraud. Rather, it simply points the user to transactions that are anomalous from a statistical perspective. It is up to the auditor to decide what further investigation is required to determine whether the transactions are fraudulent or erroneous.

Viewing the demo case results by the timeline shows that there is a spike in the number of high- and medium-risk transactions near the end of the period. Students should be able to synthesize knowledge about fraud schemes, accounting process, and the case scenario to reason deductively that if the CEO were to make fraudulent transactions to increase earnings (and therefore his compensation) those transactions would occur closer to year end because that is when the true results of operations are more apparent.

This is the *choice* stage of the project. Students have to choose the highest risk transactions (based on their knowledge and the risk scores provided by the Ai software) for further investigation. They select those transactions and add them to their audit plan with an explanation for their selection—one that they can quantify as opposed to justifying solely based on their experience, professional skepticism, or intuition. After students have completed the case they are provided the "solution" in the form of four specific transactions that were manipulated to increase profits.

Recall that one of the objectives of the auditing course is for students to compare and contrast the way that auditing is performed with and without AI. To assess that objective, students would be required to submit written answers to each of the following questions:

1. Audit is a process with multiple steps or tasks. Ai Auditor automates/performs some of those tasks. Identify the part(s) of the audit task being automated.
2. Where does Ai Auditor fit in the audit process? Does it change the process? (Refer to the endorsements of clients on the MindBridge website to get insight into the thinking of the CPA firms and internal audit staffs that are adopting the software.)
3. How are auditing tasks performed with and without Ai Auditor?
4. What errors are likely to be made by an auditor working *without* Ai Auditor or similar software?
5. What is the potential impact of those errors?
6. What can auditors do to mitigate or reduce the impact of those errors?
7. What errors could be made by auditors *using* Ai Auditor?
8. What is the potential impact of those errors?
9. What can auditors do to mitigate or reduce the impact of those errors?
10. How do you use the results of Ai Auditor?
11. Explain the part of auditing decision making that is necessarily performed by accountants (use the words judgment, skepticism, interpretation, validation, reasoning, and communication as appropriate).

Communication is an important part of the audit process. In the United States, auditors are themselves audited by Public Company Accounting Oversight Board (PCAOB). Therefore, it is imperative that they document the work they do and justify the decisions they make. The explanation for how they configure the software and which flagged transactions to investigate further are critical elements of their audit documentation.

When introducing AI software into a course, it is important to explore where and how it fits into the existing process or how it changes the process. Having students compare and contrast the current process with the AI enhanced process is a useful way of ensuring their comprehension.

DISCUSSION

The case example presented above exhibits two important aspects of the framework for online learning. First, as an example of problem-based learning (PBL), it demonstrates the particular suitability of this framework to an online learning environment. Problem-based learning requires a student to conduct a detailed and iterative process of exploration, information gathering and analysis (Barrows, 1986). Consequently, in PBL instructors tend to shift away from their traditional role as lecturers, and toward a less directive and more consultative, facilitative role (Walker & Leary, 2009). Accordingly, the onus for solving the problem, and thus learning what is necessary in order to solve the problem, is placed squarely on the student.

Problem-based learning, with its emphasis on student exploration and the role of instructor as facilitator, is particularly appropriate for an asynchronous online environment. In these circumstances the instructor sets the agenda and directs students to particular tasks based on the assigned learning objectives. The student in turn explores the case, draws on appropriate resources, interacts with the AI system, and asks questions of the instructor via the communication channel provided in the online learning management system. The instructor then provides answers and feedback, monitors the student's progress through the case, and provides guidance as needed.

Second, within an online setting, the case illustrates how the human and machine roles in collaborative problem-solving can be presented to students, and what level of preparation is required of the student in order to appropriately assume his or her role. Preparation requires that the student acquire the domain knowledge of his or her profession; in this case, accounting and auditing knowledge, which is acquired across the student's entire program of study. This requirement is underscored by noting that MindBridge Ai Auditor is not a substitute for experienced, knowledgeable accountants (Celeski, personal communication, September 20, 2018). In fact, using it without some degree of accounting knowledge would be unproductive because one could not dive too deeply into results generated for transactions without understanding their context. Therefore the student clearly must be prepared with a certain level of accounting and auditing knowledge in order to understand the terminology, concepts and issues in the case, as well as the nature of the questions posed and an outline of potential solutions.

With this knowledge as a foundation, the student must understand how the problem-solving process unfolds. That understanding includes the components of the process and how those components align with the respective roles of the human and the machine. Specifically, certain components of the auditing task require data identification and extraction, pattern recognition and accuracy; that is, skills associated with the *amplifier* role performed by MindBridge Ai Auditor. The student thus understands what the AI system is capable of and therefore delegates those tasks to system. As such, utilizing a tool such as Ai Auditor allows students to develop a technical education about the process in which the tool will be applied.

The student also must understand what the system is not responsible for knowing and producing. It is important to emphasize again that Ai Auditor does *not* identify fraud. Instead it points the auditor to transactions that are anomalous from a statistical perspective by highlighting those that should be of the most interest to auditors. It is up to the human auditor to decide what further investigation is required to determine whether the transactions are fraudulent or erroneous; thus, the importance of understanding the overall context surrounding the case and demonstrating the judgment required to pursue relevant red flags.

In assuming this responsibility while reasoning through a case with Ai Auditor, and through trial and error, the student learns and assumes the role of *sustainer* along with the contextual understanding, judgement, and skepticism required to complete an audit task. Skepticism in this regard requires the student to think critically not only about the financial data and the company, but also about the results from the AI system. Again, Ai Auditor is unlikely to have full knowledge of the context when it identifies red flags, and thus the student, with the help of the instructor, will need to critically evaluate the relevance of the system's output to the current case.

Finally, the student, in his or her auditing role, is responsible for communicating the audit results and rationale to a hypothetical client. In doing so the student also assumes the *explainer* role, and as such is required to understand how and why decisions were made from the perspective of both the human and the AI system. The communication task requires the student to fully explain each element and output of the decision task, which in turn means explaining the student's engagement with the AI system, his or her evaluation of the system's results, and the contextual rationale supporting the pursuit of certain red flags and the rejection of others. Accordingly, performing the explainer role provides an integrative learning experience for the student, requiring judgement along with detailed knowledge of auditing principles and process, the specific audit case, and the capabilities and reasoning of the AI system.

CONCLUSION

The approach presented in this chapter is essentially a reconciliation of two major trends. The first is a trend we noted earlier, which is that intelligent machines are threatening many of the knowledge workers who traditionally manipulate and make decisions from data. New pedagogies are needed to teach students to collaborate with intelligent machines rather than compete with them. Although we used a specific accounting task to illustrate the use of the framework, it is important to note that the framework is generalizable to many current and future applications of AI in business education more broadly. For example, the use of control charts in quality assurance would be a good candidate for an AI application. The process that we outlined, linked closely to course objectives, is as relevant to operations management as it is to auditing.

The second trend is that higher education is moving increasingly toward online programs and courses, which is an ideal setting for teaching students the skills to work with technology within a technology-enabled environment. The online learning framework presented in this chapter addresses both of these trends. While the framework can be utilized through a number of delivery methods, including face-to-face, it is particularly suited to an online or hybrid approach in which the student's quasi-independent, problem-solving engagement with the AI system can be monitored and guided by the instructor through a standard learning management system. On a practical level, the framework is intended to teach students the (so far) uniquely-human knowledge required for them to collaborate with AI systems. On a more fundamental and perhaps societal level, the framework is intended to instill in students a critical, creative, innovative, and learning mindset. That mindset will in turn allow students to succeed professionally by partnering with AI systems in pursuit of solutions to difficult and unstructured problems, even as those AI systems continue to advance in capability and sophistication.

ACKNOWLEDGMENTS

The authors are indebted to Stefan Celeski from MindBridge, who provided important information about Ai Auditor and directed our attention to supportive resource materials.

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CHAPTER 10

ARTIFICIAL INTELLIGENCE AND EXECUTIVE DEVELOPMENT

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Artificial Intelligence (AI) has a disruptive impact on our way of life. Both optimists (Mims, 2016; Sharma, 2016) and pessimists (Gates, Hawking, & Musk as cited in Cellan-Jones, 2015; Geere & Highfield, 2018) agree on that. No matter what exactly will happen, it is obvious that AI will also impact the position and role of business schools. In this chapter, we shall focus on AI and executive education, on management and leadership development; on AI, and the content and methodology of teaching and learning.

Managers and leaders are and will be confronted with an environment, where new jobs and professions will go through big changes (Susskind & Susskind, 2015), and their own position will also be under continuous change. It will be the task of business schools to assist managers and leaders

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in finding their way in their complex, often chaotic environment. The complexity is particularly caused by the overwhelming and continuously growing quantity of available data. Business leaders will have to be able to select from this mass of numbers so as to outline the future route of their organizations.

Therefore the challenging questions for a business school is how to develop capabilities amongst business leaders to deal with this phenomena, to be capable of being aware of it, to analyze the data, and to have a creative mind-set to discover in the data the hidden links for the future. The demand for different capabilities of business leaders will result in a different content of education and learning and a new composition of faculty.

In this chapter, the case of IEDC-Bled School of Management will be presented as an example or a possible response to these challenges.

ARTIFICIAL INTELLIGENCE AND BUSINESS SCHOOLS' AWARENESS OF ITS IMPACT

What about the content and the level of discussion on AI and (management) education? Is there new evidence that AI stands high on the agendas of universities and business schools? In a meeting of McKinsey experts and shareholders, the statement by Jason Palmer that "higher education is 25 years behind the curve concerning new technologies" (McKinsey & Company, 2017) was not contradicted by other participants.

The Swedish scholar Johan Roos, a well-trained researcher, summed up the current situation aptly when he stated: "We are now stuck with an academic system in which business schools are run as if they were deaf, blind, and dumb to a completely new emerging world . . . too many professors have never worked outside of academy and are unfamiliar with the day-to-day operations of companies or the intricacies of how decisions are actually made" (Abell, Purg, Braček, & Kleyn, 2018).

It seems that the overall picture of the mind-set and capability of educational institutions to integrate AI in their activities looks quite strong.

Some schools and business schools, however, seem aware of the impact of AI. One can read that "an unprecedented and massively overdue wave of innovation in the higher education industry is about to be unleashed, and it will bring unprecedented disruption to the field" (Moldoveanu, 2018). Most AI analysts end their contributions with the remark that "digitalization of content, connectivity, and interaction is presenting a massive opportunity for a redesign of a field, where practices remained unchanged for more than 1,000 years" (Moldoveanu, 2018). Moreover, change is necessary, as much knowledge acquired during one's study for a degree will be obsolete once the degree has been obtained. Therefore, it is necessary to develop a creative school as opposed to a standard curriculum, promote self- learning, and embrace a virtual world and virtual teachers (Stuchlikova, 2016).

Rexford (2018) states that AI and machine learning can be used to learn how people learn and personalize student learning, so that they can learn at a more efficient pace than they can in today's one-size-fits-all classroom.

Artificial Intelligence algorithms are helping enhance education by collecting, analyzing, and correlating every interaction that takes place in physical and virtual classrooms, helping teachers to address the specific pain points of each student. Advanced use of AI can involve the employment of complicated computer-vision algorithms to analyze facial expressions, such as boredom and distractedness (Dickinson, 2018).

Luckin, (2018) sees that Third Space Learning is leveraging AI algorithms to help improve the performance of teachers. The combination of big data and AI could provide learners with their own personal analytics, which they can leverage to become the most effective learner that they can be.

Artificial Intelligence powered tutoring systems have shown to be effective in teaching well-defined subject areas, such as math and physics (Luckin, 2018). This implies that AI in other fields, like management and leadership development, still has to go a long way. How many more qualitative elements will it take and how different is the creation of useful algorithms in those fields? Here human faculty will have a more basic educational role and machine-learning will be less effective. J. Butler-Adam (2018) refers to an interesting implication of what he called the AI revolution in relation to curricula, teaching, and learning. He argues that if an employee wants to succeed in this era—numeracy, literacy, and understanding of how the world operates are all essential. Students studying the basic and applied sciences also need to understand the protocol and social nature of the world in which they live. For the same reason, students who study the humanities and social sciences need to understand at least the foundations on which AI is based and operates. This has implications for faculty formation in the educational institutions on business schools of the future.

SOME EXAMPLES OF ARTIFICIAL INTELLIGENCE IN EDUCATIONAL PROCESSES

There are a number of interesting AI implementation initiatives in the educational process, for example:

- *The Zoomi platform:* tracking micro-interactions, such as viewing specific slides of pages of PDF documents, replaying specific parts of a video, or positioning a question or answer on a discussion forum;

- *Third Space Learning:* an online educational platform to provide one-to-one math tutoring (https://thirdspacelearning.com/);
- *ITS (intelligent tutoring system):* an AI learner model providing a personalized learning experience;
- *MATHia:* an AI powered math-learning platform, developed by Carnegie Learning (https://www.carnegielearning.com/login/index.html);
- *LMS (learning management system):* providing the innovation platform that promises to aggregate and integrate across isolated innovations in learning and intercultural design; and
- *Initiatives like the iPad Classroom 2.0:* using an educational concept of a Swedish company "embrace technology and educate teachers to be coaches" (Apple Classroom).

Although these initiatives are impressive, Ben Dickinson (2018) also argues that the results fall behind in comparison to other domains, because education and learning are social experiences that are extremely hard—if not impossible—to automate. He believes that AI cannot replace teachers, because it has no self-awareness or metacognitive regulation, and it lacks empathy. Steven Ritter (Dickinson, 2018), chief product architect at Carnegie Learning, discusses the aspect of collaboration. Students often learn more from working in groups and with each other, than they do from listening to lectures and solving problems at their own pace.

It is evident that AI is still mainly used as a tool to improve methodology and teaching methods, particularly in mathematics and physics. In many fields related to management and leadership development, a balanced approach between AI and personal teaching and learning has to be found. What all this means for the content of curricula is an even more neglected problem. We shall address this issue in the next chapter.

ARTIFICIAL INTELLIGENCE, A REVOLUTIONARY SUPPORT TO TEACHING AND LEARNING: WHAT ABOUT THE CONTENT OF CURRICULA?

What bothers schools and rating agencies the most is the evolution of education from in-class to blended and then to online. Other forms, such as online courses and MOOCs, do not contribute to the improvement of quality of education. This type of education is certainly not superior to working in groups, especially on executive programs with participants who have a rich experience in various segments of business. But online learning can have an important function in a world where executives are continuously confronted with technological development and movements in their markets as well as increasing time stress. It fits in the concept of continuous education and self-learning. However, if we think about the requested content and quality of education in a world of AI and big data, we realize the shortcomings of e-learning. What amount of it and what methodology can help business schools to prepare managers and leaders for the new times? Firstly, schools have to be aware of the challenges and find a response to the following issues:

1. How to lead an organization on the way to Industry 4.0 and beyond. How to lead in a world with such diverse views on the consequences of AI. How to manage social concern and social interest.
2. How to lead and manage disruptive change. This can be learned from the experience of colleagues in graphic design, logistics, the warehouse industry, the harbor industry, the post sector, and the publishing industry. They all got confronted with disruptive changes back in the 1970s and 1980s. E-information and case studies can provide support, but cannot replace direct contacts and exchanges of tacit knowledge and tested solutions to such complex processes.
3. How to lead in a world where "by many measures corporations are more central players in global affairs than nations (Barber, 1995); a world where global companies, such as Google, Facebook, and Instagram, are developing in a way that cannot be controlled by their own leadership.
4. How to lead with the support of AI. The availability of big and deep data makes the decision-making process more complex. To translate a quantity of information into quality for the stakeholders or the strategy of an organization one needs a leadership capacity far beyond data analysis. It takes developed senses, creativity, and the courage to drive an institution by using and developing the right side of the brain. The Dutch prime minister recently reacted on being buried in data by the opposition by saying: "If you think the country can be led by data, just replace me with a computer."

   Also, in an increasingly psychologically demanding environment, there will be a growing need among business leaders to take breaks for reflection, mentoring, and coaching.

It is evident that leading in the time of AI with disruptive changes and massive accountability of data requires a dramatic change in the content of management and leadership development. It will be necessary to develop a future mind-set involving thinking how industries are getting disrupted, not only in a negative sense, but also positively, in an optimistic, opportunity-creating sense (Roos in Abell et al., 2018).

THE FUTURE CONTENT AND ORGANIZATION OF MANAGEMENT AND LEADERSHIP DEVELOPMENT

In the traditional management development model, the stress was on functional topics so as to increase the overall knowledge of managers. This was supposed to improve their ability to oversee the total business. A minor part of the programs dealt with management and leadership skills to improve the capability of managers to communicate and cooperate, particularly at the board level. Later, the development of new technological and organizational processes were accompanied by increasing attention to management models that included improvement of communication skills so as to respond to the active participation of employees in decision-making consultation and the need for increasing relationships with other stakeholders.

In the development of managers, more attention was paid to team building, team performance, and conflict handling. This was also made possible by the introduction of e-learning: Functional knowledge could be increasingly acquired in this way. Now, the emergence of AI in learning and teaching is on the way to transferring most functional knowledge programs onto the Internet. Educators in this field, as for example in the iPad Classroom, are taking the role of coaches, assisting learners individually, in online classes and in the communities. These developments have a great impact on the composition and recruitment of faculty. In the "future" stage (see Figure 10.1) faculty in the fields of functional knowledge and team building will be composed of facilitators, coaches, and skills developers, such as mind-set developers—philosophers, social scientists, artists, and senior business leaders—who will offer their experience and tacit knowledge, and perform as mentors to executive students and colleagues. Our view on the future composition of faculty is based on the hypothesis that the further AI develops, the more it will be created for human intelligence (HI), not only for the art of analysis, interpretation of data and systems, but for other nonquantitative aspects, such as intuition, experience, and creativity. We see the following challenges in content and faculty composition in business schools (Figure 10.1).

ON THE WAY TO THE FUTURE: THE CASE OF IEDC-BLED SCHOOL OF MANAGEMENT: ARTS AND LEADERSHIP

A large number of business schools have already introduced AI technology support methods in their educational systems. A much smaller number of business schools have moved from the left side to the right side of the brain in their programs. IEDC-Bled School of Management can be considered a forerunner in this respect.

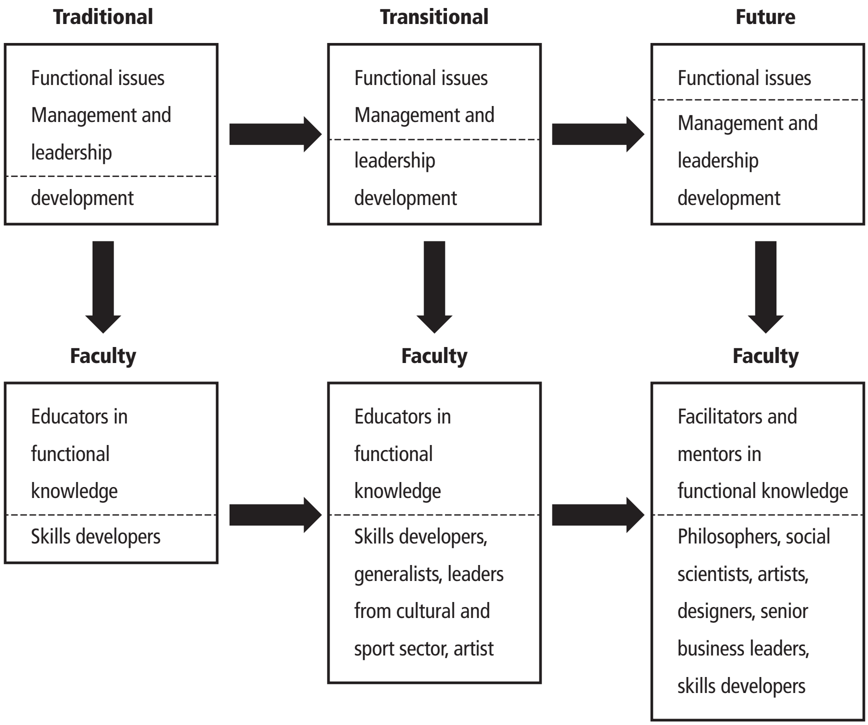

Figure 10.1 Changes in content of programs and faculty composition of business schools.

In the late 1990s, as the IEDC's dean built new processes for the management school, she said: "I cannot and do not want to build the biggest management school, but I can try to build the most beautiful one" (Stepančič et al., 2013). She launched the slogan "a creative environment for creative leadership." IEDC has all the features of an art gallery. It is not simply a showcase, like the art galleries at other business schools. It is a tool for developing managers and leaders. The inspiration for this endeavor came from publications in the last decade, stressing that the practice of managing and leading organizations in the 21st century in the world needs new ways of leadership development, because conversations, assumptions, and ideologies are constantly changing (Adler, 2006; Giddens, 1991, 2003; Harman, 1998). Without mentioning disruptive technological developments caused by AI, yet looking to the continuously growing globalization and complexity of decision-making, Karl Weick (2007) wrote:

> Consider the tools of traditional rationality [...] Those tools presume that the world is stable, knowable, and predictable. To set aside some of those

> tools is not to give up on Friday a workable way to keep money. It is only to give up one means of direction finding that is ill-suited to the unstable, the unknowable, and the unpredictable. To drop the tools of rationality is to gain access to lightness in the form of institutions, feelings, stories, improvisation, experience, imagination, active listening, and empathy. All these nonlogical activities enable people to solve problems and enact their potential. (p. 15)

This expresses exactly what other scholars intended to say in their studies on the relationship between art and leadership. Nancy Adler (2006) wrote about the art of leadership. Mary Tschirhart (1997) discussed artful leadership. Michael Jones (2006) expressed very well what leadership needs in these times: "Leaders will need to develop a capacity for experiencing and understanding new and more subtle intelligence, a way of knowing that it is not a separate mental function, but rather the source of an imaginative response to our world" (p. 4). As a kind of a sense organ, human intelligence reaches out and makes tentative contact with wholeness—things of an order larger than what we can see directly, making visible what is hidden, so as to create an awareness of what cannot yet be heard or seen. It is about the development of "aesthetic development" (Mucha, 2009).

"Artful leadership" calls for searching for "the most beautiful ways" to respond to challenges. "Beauty" in this respect can be found in sustainability, transparency, openness for trustful relations with stakeholders, and social responsibility.

IEDC responded to the needs to develop "artful leadership" in various ways. IEDC is using music to make executives better listeners and help them visualize how composers dealt in their compositions with disintegration and reintegration, using visual arts to make executives better observers. Visual art styles are also used as metaphors for leadership styles in order to make it possible and easier for executives to discover their leadership style and make it possible to communicate it. In addition, attention is paid to the power of using metaphors in speaking, and reporting, and film is used to discuss different leadership styles. All this is about personal development, including a creative mind-set and the use of senses to be ready for the challenges of today and tomorrow (Sutherland & Walravens, 2011).

CONCLUSION

We live in new times, as everybody before us. However, technological change is taking place with a speed that we never experienced before. AI is accelerating the formation of global networks and the production of an unlimited quantity of data. It will be a challenge for everybody to live in this reality, particularly for business leaders, whose decisions will have an impact on the lives of many. Business leaders have to move forward on the road between the forecasted Utopia and meltdown. They will have to deal with social concerns and social unrest. Leaders in the 21st century will have to inspire and lead people in making decisions on complex ethical issues, such as the possibility to use AI to manipulate people or benefit from the progress in science to upgrade human beings. What kind of leadership will be needed in the future? The "Homo Deus" of Yuval Noah Harari (2016): a human being with God-like powers? Or what we call "creatura adaptica": a post-humanist concept of a being with perfect abilities to adapt through embodying different identities and understanding the world from multiple, heterogeneous perspectives (Haraway, 2015)?

One thing is clear, new times need new leadership. As handwriting will disappear after thousands of years as a craft and will become an art, the craft side of the leadership will be necessarily complemented and replaced by artful leadership. There lies the challenge for business schools, as well as for management and leadership development.

Artificial intelligence is an excellent tool for creating space in business schools for the necessary development of the right side of the brain of business leaders. It is imperative and urgent to recruit faculty who will make this possible, and to create an institution that offers not only high-tech solutions, but also high-touch ones. One could say that the business school of the future will be the "escape room" for leaders and managers, where they learn to understand available information, but develop an ability to find creative and innovative solutions for the issues that they are confronted with.

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CHAPTER 11

WHEN ARTIFICIAL INTELLIGENCE MEETS AUGMENTED REALITY

Implications for Management and Business Education

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ABSTRACT

Emerging information and communication technologies (ICTs), in today's information age, have the potency to leverage economies of scale and economies of scope to positively impact the lives of a large number of people at the same time. One such field in which the emerging ICTs could cast a significant impact is management and business school education. Managers and business leaders of today must deal with much more information and uncertainty than what their predecessors had to do. This demands them to not only be

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flexible but also agile. This agility demands training and education that is not only adaptive in nature but also captivating for the learner. Two emerging technologies, that when combined, could equip and enable an adaptive and captivating pedagogy: artificial intelligence (AI) and augmented reality (AR). Artificial intelligence combines "almost human level" intelligence and logical deductions with fast computing speeds. This helps in gauging and responding to needs of learners at an enormous scale in both off-line and online environments. Augmented reality on the other hand combines human senses (such as sight, sound, taste, smell, touch) into a technologically driven experience. The objective of this chapter is to conceptualize an integrated pedagogical framework that is well grounded in extant theories and that encompasses the adaptive adroitness of AI with the immersive abilities of AR for efficient delivery of business school and management education.

Business school and management school education are undergoing change at the same pace as the turbulent business and macroeconomic environment and geopolitical scenario (Kaplan, 2018). Most of the concepts of business and management school education are derived from allied disciplines of psychology, economics, engineering, and others (Koontz, 1961). As the theories in these fundamental domains evolve so does their pedagogical derivations in the field of management and business. The rate of change is slow but it behaves more as a step function (stage model) than an S-shaped curve (Lucas & Sutton, 1977).

To keep pace with the VUCA (volatile, uncertain, complex, and ambiguous) environment, the management and business school educators and administrators need to be adept at cognition of this change and also the emerging technologies that are part of the educational paradigm (Lawrence, 2013). The disruptive effect of fast technological changes is redefining the essence and implementation of today's pedagogical goals.

There are multifarious technologies that are changing the way students learn and teachers teach today. And extant literature in information technology has already informed us that emerging technologies can help in creating meaningful simulations and AR experiences. But needs further and deeper delving. One of the paramount ways to take note of latest happenings in the (education) technology sector for academia is to leverage and refer to the latest happenings in the technology industry space (Deming, 2018).

One of the prominent sources of such information is reported by Gartner—a global technology research and advisory firm and a member of the S&P 500. The hype cycle by Gartner that is released every year gives an overarching snapshot of key information and communication technologies and their maturity levels (Linden & Fenn, 2003). The 2018 Gartner Hype Cycle,[1] as shown in Figure 11.1, gives an overview of various merging technologies making waves.

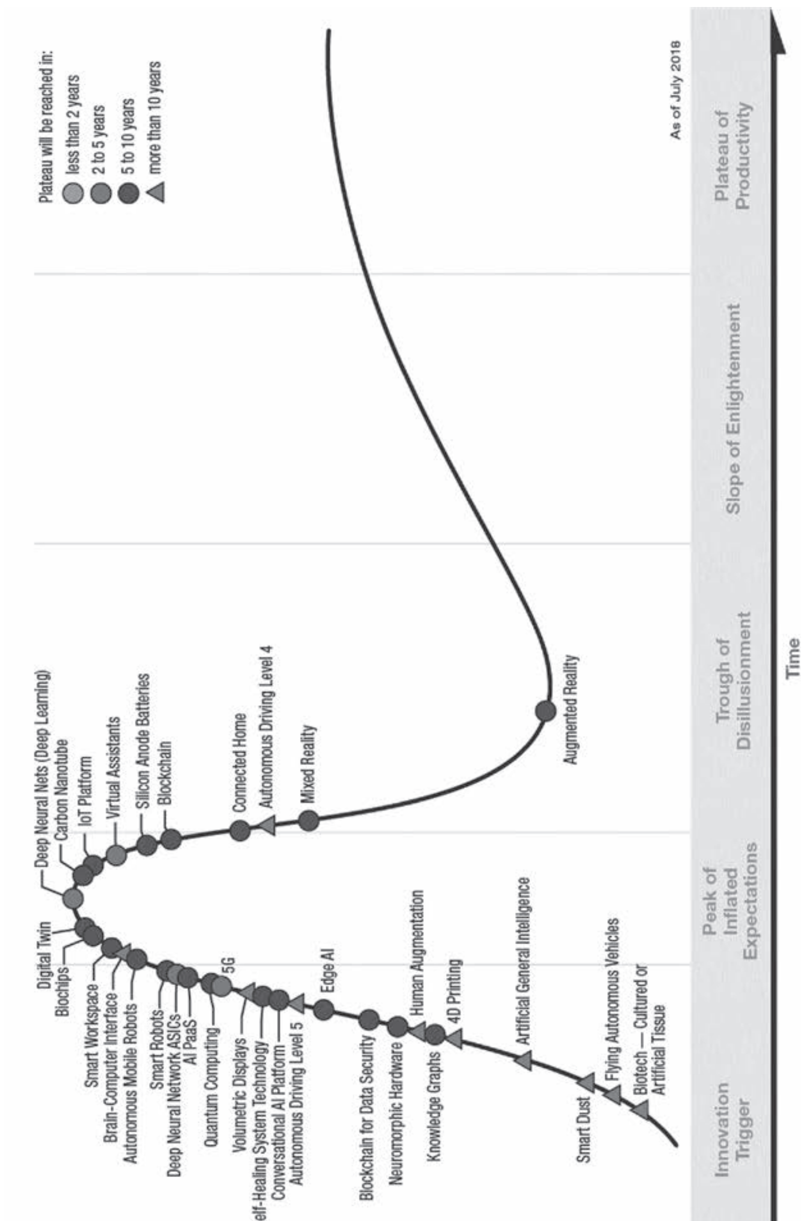

Figure 11.1 Gartner hype cycle 2018 for emerging technologies.

As is evident, from Figure 11.1, there are several technologies that are trending towards maturity and expectations. The lead amongst them being AR (Basole, 2018). There is a lot of hype around AR as the immersive technology that will have the greatest impact on organizations in the near future.

But far too less is known about it and is often confused with the allied terms such as virtual reality and mixed reality (Mann, Havens, Iorio, Yuan, & Furness, 2018), when on the contrary they are different and the same has been shown in Figure 11.2. Taking transition from the physical (tangible) world to the virtual world as a scale, one could better understand this distinction. Augmented reality superimposes on top of the physical world objects, thereby, providing a near-real-world extension to the real world. On the other end of the spectrum is the virtual reality realm which is a total virtual world with the context being real world like. The mixed reality domain lies midway between the augmented and the virtual reality.

The immersive nature of the aforementioned technologies when applied to conventional learning settings can open doors to infinite educational possibilities, as stated in extant literature (Culic & Radovici, 2017; Domingo & Forner, 2010; Kortuem, Bandara, Smith, Richards, & Petre, 2013). But what was missing was the pragmatic conceptualization and empirical testing of this concept. This chapter attempts to conceptualize AR enabled learning environments in the business and management schools. This chapter proposes a conceptual approach that connects AR to furthering of the way business and management school education is imparted. Augmented reality adds to the conventional ways of education an immersive experience, thereby effecting all the four realms of experience, thereby giving a more meaningful business school experience and helping educators and business school administrators deliver a management education that can appeal to the students and managers by sensing and responding to their learning needs (tom Dieck, Jung, & Rauschnabel, 2018). Augmented reality alone

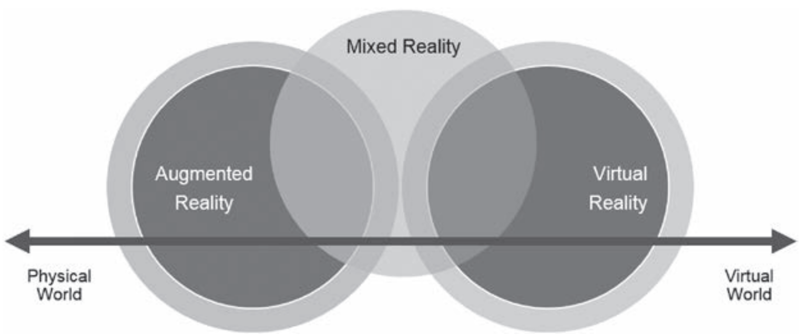

Figure 11.2 Distinction between augmented reality, mixed reality, and virtual reality (Derived from Gartner's mixed reality representation).

is not sufficient in deliverance of this educational agility (Ghilic-Micu, Mircea, & Stoica, 2011). Adaptive capabilities coupled with AR can help management education imbibe immersive capability and personalization ability—both at the same time, thereby giving an opportunity to have enhanced business school education experience since the education can sense an individual learner and respond with an adaptive learning environment.

This chapter is organized in the following sections: The first section is the introduction, the second section is the theoretical framework that forms the basis for the third section which is the proposed conceptual model. The fourth section is the conclusion. Finally, the discussions and implications are presented at the end of this chapter.

THEORETICAL BACKGROUND

For management and business school teaching to be effective, the critical deliverables encompass—continuous modernizing of syllabus, real-time connect with the corporate world best practices and a standpoint to train students and future managers to be effective in the face of ambiguous situations. Management and business education is unique in its fundamental focus on teaching students those techniques necessary for enhancing value.

Value can have varied dimensions and augmentation of any one of those dimensions and is one of the core things underlying the ultimate aim of management and business school education. Figure 11.3 describes a value pyramid proposed by the industry consulting leader, Bain and Company, and published in *Harvard Business Review* which is a value derivation of Maslow's needs hierarchy (Almquist, Senior, & Bloch, 2016). This model helps us in understanding how value is added to businesses. This understanding is important in the context of a business school, because business school students, after graduation, join organizations or start their own organization wherein creation of value is one of the main activities. This also gives a tangible anchor to delve deeper into what could be the skill set that is expected out of a business school graduate.

Besides, augmentation of value, there are several other skills that are expected out of a business school student or a young manager. Aiken, Martin, and Paolillo (1994) revealed that the crucial abilities anticipated from management studies are "ability to communicate, interact with others, ability to take initiative, problem solving skills, business knowledge and creative thinking" (p. 2). Table 11.1 encapsulates the diverse studies addressing the same. In this competitive and ever-changing environment, managers have to address the challenges through systematic insight (Sambamurthy, Bharadwaj, & Grover, 2003) thereby evaluating all alternatives before making a decision. Imparting this ability, amongst others, is of paramount

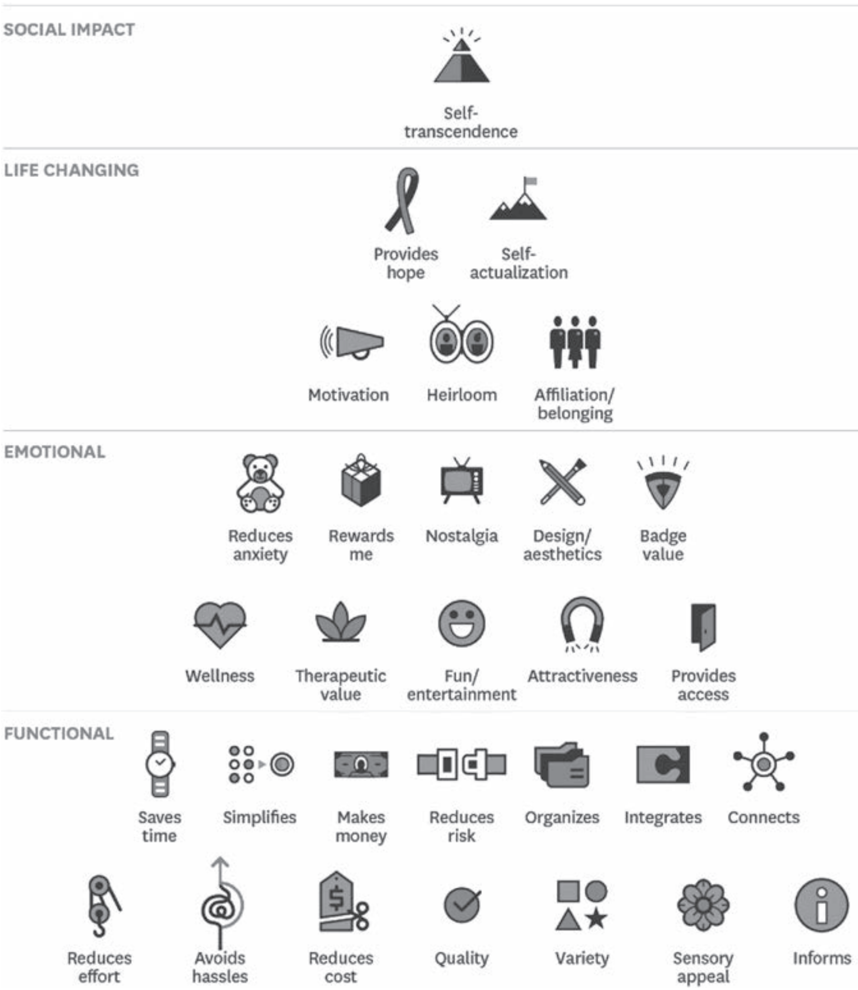

Figure 11.3 Value pyramid proposed by Bain and Company.

importance for management schools. Given the current VUCA environment it is becoming increasingly difficult for management schools to keep up the pace.

Management and business schools of contemporary times are facing diverse challenges:

1. the impact of globalization and geopolitical changes on the business environment and the business school education (full time and management development programs) and how to respond to this

phenomenon; the shortage of technology qualified faculty and the limited options to deal with this shortfall;
2. the need to introduce social skills and soft skills into the curriculum while preserving the more analytical and concept based courses;
3. the effects of information and communication technologies on teaching and learning methods; and
4. the need to handle with competitive forces and secure a long term competitive position.

All these challenges if fixed efficaciously, craft chances for management and business schools to offer quality management training and education. It allows the business schools to have an evolved management education delivery framework—one that can sense and respond to not only the management students' needs but also the changing geopolitical scenario. This management education framework has been referred to in extant literature as business school education agility which is the dependent concept in this chapter.

As proposed by Gupta and Bharadwaj (2013), business school education agility encompasses the ability of educational pedagogies to sense and respond to the uncertain needs of the management and business school students and companies. To achieve this state of business school

TABLE 11.1 Review of Studies Envisaging Abilities Desired Out of Management Graduates

Study	Management Abilities
Dumas, 2002	leadership, critical thinking, teamwork, and cooperation, active and lifelong learning abilities
Conrad & Newberry, 2012	Outcome based managerial and communication skills
Eberhardt et al., 1997	Oral and written communication, interpersonal and leadership skills, decision-making capability, analytical skills, previous work experience, financial skills, and technical skills
Gupta & Bharadwaj, 2013	Ability to sense and respond
Robinson et al., 2007	Problem solving and analytical skills, decision making, organization and time management, risk taking, time management, creativity, innovation and change, lifelong learning, motivation
Levenburg, 1996	Communication skills, presentations skills, teamwork, decision-making skills, leadership, project management, multicultural appreciation
Verville, 1995	Ability to use technology, a focus on client value, ability to work in teams, executing commitments, and building and applying competencies

education agility, it is important that both active and passive participation and both immersive and absorptive abilities of business school students are activated. For this, what is requisite, is the acceptance and application of immersive technologies such as AR and adaptive capabilities fostered by technologies such AI.

For improved comprehension of how this business school education agility can be achieved, we combine two widely accepted seminal theories from the social and natural sciences and ground our conceptual model in them. Theory of experiential learning (Kolb, 1984) by Kolb helps in understanding the importance of immersive learning and the contingency theory (Fiedler, 1964) proposes that optimal operations and decision-making is not a well-crafted formula science but instead is contingent upon various internal and external constraints. And extant literature in information technology has already informed us that emerging technologies can help in creating meaningful simulations and AR experiences. Theory of experiential learning is a holistic perspective that combines experience, perception, cognition, and behaviour. One of the important constituents of our conceptual model is learning with experience, which has been introduced through the concept of AR.

The learner is experiencing a simulation of real time environment, reflecting upon the same and making decisions at the same time. As shown in Figure 11.4, both active and passive participation and both immersive and absorptive experiences are occurring for the learners when AR is coupled with the existing business school education pedagogies such as case studies, lectures, live projects and so forth. Given the rise of online training and education sources and the gig economy, the contingency theory (Fiedler, 1964) emerges as the guiding theoretical paradigm that proposes that optimal operations and decision-making are not well crafted science formulas but instead are contingent upon various internal and external constraints. And since these constraints and dealing with this constraint in a VUCA environment needs adaptive abilities, this demands extensive use of data capture and analysis—both in real time. This brings into the picture AI and its ability to foster business school education along with AR's immersive abilities.

PROPOSED CONCEPTUAL MODEL

In this section we are proposing a conceptual model based on the theoretical underpinnings highlighted that connects the immersive abilities of AR with the adaptive abilities of AI to the business school education agility via four realms of experience economy. As shown in Figure 11.5, our conceptual model comprises of three sub-paradigms viz emerging information and

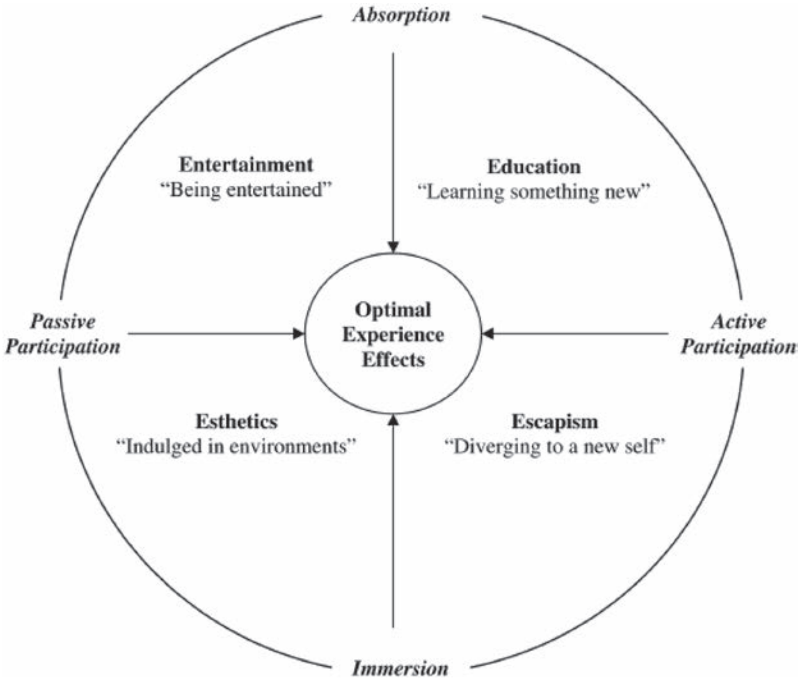

Figure 11.4 Four realms of experience. *Source:* Adapted from Pine and Gilmore, 1999.

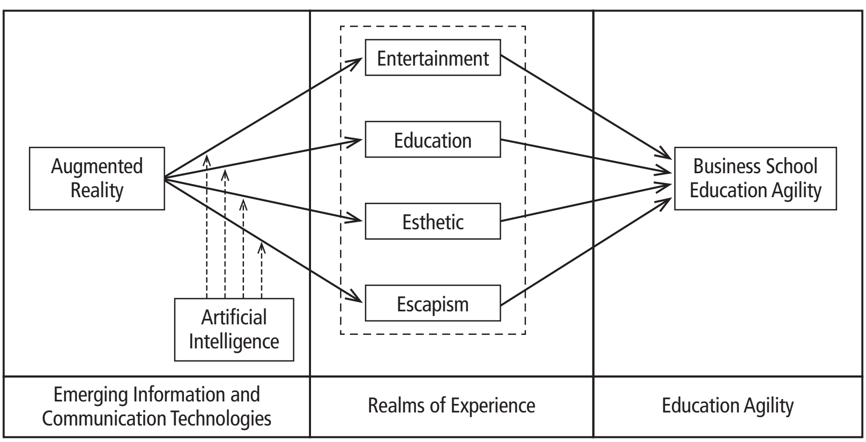

Figure 11.5 Proposed conceptual model.

communication technologies (Kolb's theory), realms of experience (Pine and Gilmore [1999] experience model) and education agility (contingency theory). These three sub-paradigms help us in knitting together a conceptual model that augments management school education experience in the contemporary time.

The following paragraphs discuss the various elements of the proposed conceptual model (Figure 11.5) in detail.

AUGMENTED REALITY

Virtual environments offer the likelihood to restructure the actual world as it is or to generate entirely new worlds, providing experiences that can help people in understanding (business and management concepts) as well as knowledge to perform precise tasks. Augmented reality presents a virtual learning environment that enriches the real world, merging of real and virtual worlds to produce new environments and visualizations where physical and digital objects coexist and interact in real time. In learning situations that are partly virtual-like, such as AR, students can manipulate objects that are not real, and learn (business and management) tasks and skills. The benefit with AR learning is that there are no "real" errors. For example, if a fire-fighter learns how to fight various types of fires, or a surgeon learns laparoscopic surgery in an AR situation, there are no real consequences if mistakes are made during training. These types of training provide opportunities for more authentic learning and appeal to multiple learning styles. Augmented reality applications, that can enhance textbooks too, have the power to engage a reader in ways that have never been possible. For example, use of QR codes in (management) text books that can trigger AR experiences (DiSaia, Creasman, Mannel, McMeekin, & Mutch, 2017). And management studies have always been about experience. Just imagine what it would be like if one could delve into the realm of teaching/learning entrepreneurship and new venture creation with the help of AR? This is what our conceptual model proposes.

ARTIFICIAL INTELLIGENCE

Artificial education in terms of contemporary machine learning algorithms and approaches have the ability to bestow adaptive abilities to education (Wartman & Combs, 2018). They have been used in online education and MOOCs and their integration in the offline education—particularly where business and management school education is being experimented. Decision tree algorithms and statistical models such as logistic regression (LR) and discriminant functions (DF) are being applied extensively for classification problems—for detection and classification of learners and learning styles—in the past and being used presently with changes in philosophy of application of AI from data mining to prescriptive analytics in education. The performance of these models is further enhanced with the additional computational and process methods such as feature selection, combining more than one classifier, ensemble, hybrid model, pruning specifically in case of decision tree, and taking care of over and under fitting. This helps in the paradigm of education in terms of detecting learning styles, subject specific learning deficiencies and so forth. For business school students this would mean matching the ideal student with the ideal company for possible live project or internship experience. Another sub-domain of AI that is enabling higher education (Chi, Qin, Song, & Xu, 2018) is called natural language processing (NLP) which combines the natural language understanding (like the system that detects plagiarism in assignments) and natural language generation abilities (like the modern day chatbots).

REALMS OF EXPERIENCE—ENTERTAINMENT, EDUCATION, AESTHETICS, AND ESCAPISM

Extant literature has listed "education" as service and an experience. Our conceptual model takes education from the worldview of being an experience wherein an experience is defined as "events that engage individuals in a personal way." According to Pine and Gilmore (1999), there are four realms (or dimensions) of experience differentiated by the level and form of (learner) involvement as shown in Figure 11.4. Along the student/learner participation axis, passive participation of the student/learner in business school offerings characterizes the entertainment and aesthetic dimensions, whereas educational and escapist dimensions reflect active participation. Along the absorption-immersion axis, the student/learner typically "absorbs" entertaining and educational offerings of the business/management school and "immerses" in the business school environment resulting in aesthetic or escapist experiences. Although in the real world business school context, the boundaries between these four dimensions are amorphous and not very clear. In technology (AR) enhanced learning environments one could see that various pedagogical tools appeal to a specific dimension (entertainment, education, aesthetic, or escapist) of the learner/student. This helps by giving the educator the ability to tune/adjust the active/passive participation (by gamification of AR learning environment) and also the degree to which the learning environment is immersive. This would help in simulating near-real business/management scenarios and thereby imparting augmented learning to future managers.

BUSINESS SCHOOL EDUCATION AGILITY

The conceptual model (Figure 11.5) proposes learning processes, which involves a technology enhanced learning process for students with diverse backgrounds and experience, and a first-cut on-the-fly proposition of a conceptual model that is immersive and adaptive and thereby providing an excellent opportunity to experience the creative, intuitive, lateral thinking, and "right-brain" skills (Bragg, 2005) that are critical to managers. This allows educators to embrace agility (with characteristics such as sensing and responding to changes) in delivery of management and business school education. It builds upon the individual characteristics and offerings of the various components of the model (viz, AR, AI, experience realms, and business school education agility) and amalgamates the pros of all of them to yield a new pedagogical model for management and business school education. As the level of immersion increases (for example as we move from simply 360 degree photos to fully immersive AR experiences), the opportunity to enhance learning with the help of adaptive AI also increases.

CONCLUSION

As discussed in the proposed conceptual model—AR and AI combine to give an enhanced learning experience (which encompasses an augmentation of entertainment, educational, aesthetic, and escapism value elements) and this further leads to business school education agility. This, in real educational settings, happens because the use of AI and AR enhances the learning experience on the following fronts:

- *A steady spatial place*: The student achieves a strong sense of being in a physical place with physical objects, despite actually being in an AR/virtual world.
- *Self-embodiment*: The student has a body in the virtual world and is not just watching.
- *Physical interaction*: Presence is not just perceived from the visual environment; AI enabled feedback enhances the learning experience via haptic and cognitive feedback.
- *Social communication*: Students should not be "alone" in the environment, but able to interact with others even though they may be computer generated learners/characters that are controlled through an AI interface.

DISCUSSIONS AND IMPLICATIONS

Agile business school education is a new variation on business school pedagogy that combines traditional-style education with technology to provide education that's relevant today and will be relevant in dealing with unforeseen tomorrow. With the help of the model proposed, business schools can create leaders and managers that are well equipped with skills and abilities not only for today's business challenges but also for tomorrow's business uncertainties. If one goes by statistics with respect to AI, China has planned aims to grow AI's contribution to GDP to 26% and the UK by 10% by 2030. On the other hand, Japan has estimated the economic impact of AI application at JPY to be 1.1 trillion by 2045.

If one takes the context of the Indian subcontinent, it is reported that one segment of education, that is, India's digital learning, was valued at USD 2 billion in 2016. It is projected to grow at a compound annual growth rate of 30%, reaching USD 5.7 billion in 2020 as per estimates from Technopak wherein AI and connected other information and communications technology, such as AR will be a key part of growth. One of the most important reasons could be capacities of AI and AR technologies in imparting quality education to India's globally linguistically diverse population.

Business schools sometimes struggle with creating learning environments in which students can obtain authentic but low-stakes, hands-on experience; for example, working with live companies or understanding trader behaviors in the stock market. Virtual and augmented reality increasingly offers solutions to this quandary. Adopting of new technologies in management and business education will create value in terms of developing contents in regional languages and also in learning the regional languages which in turn results in better communications among regional businesses and also, business schools. New products based on these technologies will make projects such as smart classrooms with digital contents as reality.

Strategic investment in and a commitment to AI and AR will increasingly become one of the ways that campuses will differentiate themselves in a competitive environment. But adoptions of new technologies (such as AI and AR) also bring with it certain challenges, such as increased upfront capital expenditure for procuring these new technologies, training of faculty and staff, fear of technologies and equipment becoming obsolete soon—especially when the technology is still emerging. Possible strategies to address these concerns could be: Develop a probable set of use cases for AI and AR to help ascertain applications that will work well for a particular business school and avoid expensive mistakes; experiment with small and sandboxed pilots that aid in better understanding the scope of support and skilled staff time needed to maintain a larger AI and AR presence on business school campus; and experience different types and levels of AI and

AR (i.e., Google Cardboard, Oculus Rift, or Samsung Gear VR) to establish what choice of technology (platform and hardware) makes the most sense for specific educational goals

NOTES

1. https://www.gartner.com/smarterwithgartner/5-trends-emerge-in-gartner-hype-cycle-for-emerging-technologies-2018/

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CHAPTER 12

ARTIFICIAL INTELLIGENCE AND THE LEARNING EXPERIENCE

The Impact of Augmented and Virtual Reality on Teaching and Learning

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ABSTRACT

The modern technological landscape includes rapid advancements in the presence and progression of artificial intelligence. These developments impact the way executives, managers, and consumers alike conduct business, and thus impact the way universities must prepare students to succeed in the contemporary workforce. While the rapid pace of these developments has undoubtedly created challenges in the way curriculum is developed, it has also created many opportunities in the way curriculum can be delivered. In particular, the increasing presence of two subsets of artificial intelligence known as augmented reality and virtual reality have created an opportunity for educators to consider new methods of delivering course material to provide a more

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robust experience for students. In this chapter, readers will find an overview of the impact of augmented and virtual reality on the way business is conducted, the opportunities and challenges in incorporating augmented and virtual reality into classroom instruction, descriptions of vignettes that are designed to assist instructors in incorporating artificial intelligence into the learning environment, and descriptions of best practices in this area.

AUGMENTED REALITY

Augmented reality is defined as, "the result of using technology to superimpose information—sounds, images, and text—on the world we see" (Emspak, 2018, para. 1) or "an enhanced version of reality created by the use of technology to overlay digital information on an image of something being viewed through a device" (Augmented Reality, n.d.). When users engage in augmented reality, they will find entertainment, information, or an experience that blends reality with computer-generated images and/or sounds. Technologies for delivering products and services that capitalize on augmented reality have become more ubiquitous in the last 10 years. Consumers frequently connect with augmented reality via smartphones and tablets (Emspak, 2018). Smartphone applications, or apps, can incorporate augmented reality to enhance practical tasks and personal entertainment. Practical uses for augmented reality have been ramping up for decades. Weather and sports reporting are both well-known for enhancing the images shown to viewers to make broadcasts more interesting and more easily comprehendible. While green screens are considered a precursor to today's possibilities for augmented reality to enhance the way information is delivered, augmented reality software has provided the opportunity for much more advanced holographic-style images and overlays that can be placed anywhere on a viewer's screen ("Virtual Reality vs. Augmented Reality," 2015; Walsh, 2015).

A popular social media app for smartphones has pushed augmented reality into the mainstream for its users. Snapchat is a social media platform that allows users to utilize their rear-facing (self-facing) camera to alter their own image with digital images and alterations and then share the images quickly with friends. These features have been popular with the post-millennial generation for several years, and the platform continues to advance its augmented reality add-ons to enhance the users' experience. The most recent update to the app, known as Lens Studio, allows users to create, capture, and publish two- or three-dimensional images of their choice and then share it with their friends or the greater Snapchat community. Each lens becomes a type of alternative "setting" for Snapchat users to use to further enhance their filtered photos or unfiltered images of themselves—this has provided a bit of a bridge between augmented and virtual reality for Snapchat enthusiasts to enjoy (Snapchat, n.d.).

Video games are also a natural partner for delivering augmented realities to consumers via handheld devices. Pokémon Go is a popular example of a game using augmented reality that consumers can play on their smartphone. Players worldwide can search their real communities in an attempt to "catch" virtual Pokémon characters and collect related items. Friends playing together can interact via the app and in real life simultaneously ("Pokémon GO," n.d.). While the game has decreased in popularity in the last year, this game became very widely played when introduced in 2016, and is credited as bringing augmented reality into mainstream gaming (Gardonio, 2017).

Augmented reality has impacted different industries in various ways. These technologies have opened up many new possibilities regarding product sales and marketing. Marketing firms are now creating full advertising campaigns with very advanced technological components. Some examples of popular augmented reality marketing campaigns include the Dutch Lady dairy products campaign that allowed users to scan a code on their products to be virtually transported to the farm where the products originate (Brands Vietnam, n.d.), the Absolut Vodka campaign that allowed consumers to scan their product to take a virtual tour of the facility where the product was produced and access free drink recipes (Eleftheriou-Smith, 2012), and the Pepsi Max Monster Mirror campaign, in which users looked into a digitized mirror that turned them into werewolves (Scholz & Smith, 2016). Marketers capitalize on these technologies to satisfy consumers' desires to interact with products in a way that is both personalized and immersive. A study by Scholz and Duffy (2018) concluded that

> launching a successful AR [augmented reality] app requires more than just using the latest and most sophisticated visual engines, but a strategic understanding of how the AR app can help consumers claim the resulting branded environment as their own, with themselves as the center of the app's offerings. (p. 21)

In other words, consumers enjoyed the feeling that they were the focus of the augmented reality experience, rather than the product line itself. Poushneh and Vasquez-Parraga (2017) suggested that consumers who feel impressed by augmented reality marketing services tend to naturally become authentic brand ambassadors who want to tell others (usually via social media) to engage with the brand. Industry experts have predicted that interactive augmented reality marketing will be a more than $117 billion industry by the year 2022 (Hall, 2017).

The customer experience has been enhanced by augmented reality services when shopping online. An example of this type of service is a virtual fitting room, which allows shoppers to upload a photo of themselves and then "try on" clothes on their computer or mobile device. Shoppers can adjust sizes and colors with a single click to help them evaluate their available options. Studies have concluded that the availability of virtual fitting rooms for shoppers significantly improved customers' opinions regarding product quality, and increased the consumers' intent to purchase both clothing and accessories (Beck & Crie, 2018; Poushneh & Vazquez-Parraga, 2017). Similarly, Yim, Chu, and Sauer (2017) conducted a study comparing the way consumers viewed online shopping experiences for sunglasses and watches when reviewing traditional web-based product information versus product presentations that incorporated augmented reality environments to synthesize trying the items on. These researchers concluded that augmented reality delivered "effective communication benefits by generating greater novelty, immersion, enjoyment, and usefulness, resulting in positive attitudes toward medium and purchase intention" (p. 89). Home improvement stores have also realized the benefits of employing augmented reality technology on their websites. Users can now easily preview paint colors on the walls of their homes in a digital environment before they commit to their purchase (Hall, 2017). Apple CEO Tim Cook announced in 2017 that Apple partnered with IKEA—a leader in affordable home furniture sales—on a project of a similar nature. Apple worked with IKEA to develop technology that allows shoppers to view the company's furniture pieces in their personal spaces, using only a smartphone or tablet (Maggio, 2017). These are just some examples of the "try before you buy" advantage that augmented reality brings to many types of retailers.

Researchers have also experimented with using virtual tools to enhance online dating services (Frost, Chance, Norton, & Ariely, 2008). Based on the notion that augmented reality environments can help match people with products, these researchers conducted a study that used augmented reality to help match people with people. They compared the perceived success of virtual dates to traditional online dating messaging and found that couples who took part in a virtual date (attending a virtual show at a museum together, etc.) were more inclined to want to meet their date in person than the consumers who used only the traditional messaging features of the dating site.

Arguably, augmented reality has had the biggest impact on the tech industry, with countless new possibilities for smartphone applications now available for developers to create. A growing category of new apps allows for location-based content aggregation. Essentially, users are able to "leave" and "pickup" data left by other users in the same physical location. Some examples of these apps include StreetTag, a location-based app that allows users to virtually graffiti the structure of their choice and make this graffiti viewable to others, and Wikitude, a service that allows users to overlay their camera images with virtual markers that offer information about local attractions (Bower, Howe, McCredie, Robinson, & Grover, 2014).

Each of the examples provided supports the idea that augmented reality has significantly impacted many products and services in various industries. Noting that augmented reality technologies have only come into the mainstream in the last few decades, and that advances have become much more rapid since the widespread popularity of smartphone ownership has taken hold, possibilities for these technologies seem infinite. Familiarizing oneself with the current landscape of augmented reality products generally leads consumers to encounter and explore augmented reality's "older brother," virtual reality.

VIRTUAL REALITY

Virtual reality is defined as "computer-generated environments for you to interact with, and be immersed in" (Emspak, 2018, para. 2) and "an illusion of reality created by a computer system" (TechTerms, 2018, para. 1). When users engage in a virtual reality setting, they are immersed into a simulated environment. They hear and see what happens in their computer-generated surroundings as if they were actually experiencing it. While augmented reality allows consumers to enhance their reality, virtual reality allows consumers to escape it completely. Like augmented reality, virtual reality can also enhance both practical tasks and personal entertainment. Consumers most frequently experience virtual reality by wearing a headset-type device designed to provide access to immersion in an imaginary world ("Virtual Reality vs. Augmented Reality," 2015). Practical uses for virtual reality include training and simulations used to prepare professionals like surgeons, airplane pilots, emergency responders, and so forth. The gaming industry has designed and produced technology that allows players to enter imaginary worlds, with or without their real-life friends, and experience games as if they are truly living in a fantasy world (Bradley, 2018). A popular virtual world that includes many functions and possibilities for interaction is known as Second Life. This system allows users to create avatars of themselves that can interact with places, objects, and other avatars as desired (Second Life, 2018).

As the technology develops, devices that allow for virtual reality gaming systems are becoming more affordable, and therefore more accessible by gamers of all ages. One reason for increased affordability is that the equipment is now being designed to work specifically with certain gaming systems as well as independently of those systems, giving users more choices at less expense (Gardonio, 2017; Terdiman, 2018). Certainly the concept of virtual reality has played a role in the evolution of several industries and opened entirely new lines of business. Some analysts predict that the virtual reality gaming industry will be worth more than $38 billion by the year 2026 (Terdiman, 2018).

Virtual reality worlds have also afforded new opportunities for companies to market products. Eisenbeiss, Blechschmidt, Backhaus, and Freund (2012) examined factors that affect the behaviors of participants in virtual worlds. These researchers reported that companies doing business in virtual worlds often provided virtual products intended to boost sales of real products to certain audiences. The authors indicated that marketers can benefit from getting to know the specific populations of the virtual worlds in which they are considering participating in with their products—realizing that the users are likely there to socialize, express creativity, and feel a sense of escape from their "real life." In recent years, retailers have also introduced the concept of the "virtual store." A virtual store is an online shopping experience that presents itself to the shopper in a virtual world. A study by Pantano and Servidio (2012) reported that university students enjoyed shopping in a virtual store more than traditional online shopping, and their level of enjoyment increased as their perception of the ease of use of the technology increased. In other words, the students thought shopping in a virtual store was more enjoyable as they became more comfortable doing so. These researchers highlighted the value of tracking shoppers' activities and purchases in a virtual store, which can lead to more individualized marketing strategies. The experiential factor of virtual reality has led marketing experts to believe that consumers who engage in and with this technology have forged a path that allows for new marketing strategies to take hold. Jackson noted (2017):

> When the practice of selling people an experience has become the secret ingredient for tapping consumer markets—and particularly the Millennial consumer market that is so large, expansive, and accepting of new technologies—marketers cannot afford to underestimate the power that virtual reality has to reach new levels of engagement with global audiences. (para. 12)

Farshid, Paschen, Eriksson, and Kietzmann (2018) outlined several ways that virtual reality has already affected business-as-usual. These authors mentioned the value of virtual tours of both virtual and real spaces like museums, farms, and real estate. Design and construction have benefitted from alternate worlds in which they can showcase new buildings and spaces that can be offered to clients for a "test run" before they commit to specific plans. Realtors allowing a potential buyer to tour a home in a virtual version of the house have realized the benefits of leveraging virtual reality for their clients' advantage. Some hotels have adopted similar technology to allow potential guests to tour their property and guest rooms prior to making a reservation (Hall, 2017). Similarly, Leotta and Ross (2018) found that virtual reality has already changed the travel industry, and explored new concepts that are being developed and applied in virtual tours of countries, cities, and tourist destinations all over the world. Travelers are able to make more informed decisions about where to go and what to do once they experience a destination in virtual reality.

Researchers have also named training and development as an area that has realized major benefits from offering services for clients in virtual worlds. Employees can participate in immersive training exercises in virtual environments that allow them to repeat a simulation as many times as they need to master a concept or skill (Farshid et al., 2018). Many diverse industries including education, healthcare, beauty/aesthetics, law enforcement, and legal services require a minimum number of face-to-face continuing education hours each year for an individual to maintain certain licenses and certifications. Training in virtual environments can open possibilities for employees to learn about a huge variety of topics without ever leaving their offices. The cost of attending conferences and workshops could be reallocated to the cost of attending the same meetings in virtual spaces, with more possibilities for such being developed every year.

OPPORTUNITIES IN INCORPORATING AUGMENTED AND VIRTUAL REALITY INTO CLASSROOM INSTRUCTION

Fortunately for faculty in higher education, the popularity of incorporating augmented and virtual reality into teaching practices is on the rise, and the rapid pace at which these methods are being introduced in various ways is breeding a fast-growing body of literature intended to help other faculty implement these practices in a way that is beneficial to faculty, students, and the learning process. To date, much of the information published has focused on the hard sciences, but the body of knowledge surrounding using augmented and virtual reality in the social sciences is growing. Faculty teaching students in business disciplines such as management and marketing should take note of the aforementioned impact that augmented and virtual reality technologies have had on consumer experiences and behaviors, and consider some of the following benefits and opportunities that recent reports have found when using these technologies while teaching in social science disciplines.

Miller (2014) reported that the main benefit for the usage of virtual worlds in distance education is the increase in student interaction and collaboration afforded by the technology. He predicts that distance education courses will see a heavy increase in participation in virtual worlds as the technology continues to become more affordable and easier to use. Similarly, Liarokapis and Anderson (2010) highlighted the benefits of faculty being able to use augmented and virtual reality tools as a way to explain concepts to students in online courses in a way that mirrors a classroom lecture or demonstration as well as discussion. These researchers suggest that these technologies take the concepts of the video-lecture and the online discussion board one step further, allowing the students to feel as if they are participating in the experiences, while still enjoying the benefits and flexibility of the online classroom.

Surveying business majors, researchers Delello, McWhorter, and Camp (2015) conducted a study to measure student perceptions of the use of the augmented reality application, Aurasma (now rebranded as HP Reveal), for a class assignment. Students downloaded the free app on their devices and created their own content-specific augmented reality overlay item that could be used by the class to reinforce a course concept. In this study, students majoring in human resources were tasked with designing a training plan used to onboard new employees to a (fictitious) organization. Students majoring in marketing were tasked with creating an augmented reality promotional initiative for an (fictitious) organization. A majority of the students in both of these groups reported that the app seemed intimidating at first, but became easier to use as the term and project progressed, and that the augmented reality tool employed in the project enhanced their learning experience. A majority of both groups also reported that they believed they could use this (or a similar) technology in their future careers within their field. These authors also offered an interesting recommendation that faculty consider completing similar projects with their students using real-world clients as an element of service-learning business courses.

Other studies examined student participation in project-based experiential learning exercises within the virtual-reality platform Second Life and observed high levels of student engagement while using this technology (Jarmon, Traphagan, Mayrath & Trivedi, 2009; Mayrath, Traphagen, Jarmon, Trivedi, & Resta, 2010). Mayrath et al. (2010) also noted that students felt an increased sense of collaboration with their peers across campus when completing assignments using the Second Life platform. Jarmon et al. (2009) also found that students were afforded a global platform when using Second Life to deliver a presentation. These researchers explained that traditional sections of a given social science course required students to give a PowerPoint presentation in front of their classroom, allowing only the students present to be involved. When these researchers taught course sections that utilized Second Life for the end-of-course presentation, students were able to attract a global audience that included students from other schools as well as interested parties from discipline-related organizations. These students reported high satisfaction with the active engagement afforded by the use of the virtual reality environment. Ramirez (2015) reported that more than one third of students surveyed expressed interest in attending these types of topical virtual lectures. Presentations in virtual worlds allow for students to be exposed to lectures in various, often specialized disciplines.

Rizov and Rizova (2015) found that incorporating augmented reality technology into their classrooms led to higher levels of student interest in the course material as well as increased understanding of the material. Lee (2012) mentioned that faculty could also increase student interest in course material by introducing and adopting textbooks that use augmented reality technologies. Augmented reality features in textbooks vary widely, but most commonly include features that allow a student to scan a type of barcode that "unlocks" a website or an app on which students can view additional text, listen to an audio file, view a video, play a game, or experience an interactive model. This creates a sort of relationship between the text and the student, so that rather than simply reading the text, the students are participating in the text.

As discussed previously, video games are one industry for which augmented and virtual reality have been paramount. In a similar vein, universities are starting to realize the benefits of the "gamification" of certain course material made possible by these immersive technologies. Chandross (2018) reported that serious educational games that take advantage of these technologies and are designed to enhance learning maintain some advantages over conventional teaching in the higher education environment. The advantages identified include providing an opportunity for students to use what they have learned repeatedly until a skill has been mastered, increasing student engagement and motivation, and providing learners with a sense of reward as they achieve certain milestones within the game (by earning points, prizes, badges, etc.). He contends, "Game worlds and mixed reality are rapidly developing fields which any educator with even a passing interest in leveraging student success would be advised to track as it unfolds" (para. 5).

While many faculty teaching in social sciences and business-related disciplines organize field trips to help students see the concepts discussed in class being applied in a real-world setting, the logistics of such trips can limit the possibilities for the experience to a small region, and thus a small range of options. Gardonio (2017) highlighted the affordances of using virtual reality to replace traditional field trips. Opportunities to tour manufacturing facilities, innovative research and development labs, modern retail spaces, densely populated urban locations, foreign markets, and so forth, abound when the "travel" all takes place in the classroom.

Lastly, the mere idea of incorporating virtual reality into classroom instruction in a single program can be leveraged in a number of ways that benefit the university as a whole. Miller (2014) found that using virtual reality technologies in a degree program was a selling point for potential students. Similar to a winning football team attracting students who have no intention of playing football, augmented and virtual reality technologies could help sell the school to students even when they are not sure that they would be taking the specific course or courses that incorporate the cutting-edge technologies.

Present-day opportunities in incorporating augmented and virtual reality technologies into classroom instruction are increasing and change at a rapid pace. The currently identifiable, research-based, significant opportunities to enhance learning that are afforded by these technologies include:

- Participating in virtual worlds to enhance a sense of student community and provide a broad, diverse audience (including private organizations and other stakeholders of business programs) with which to exchange information in both online and on-ground courses.
- Incorporating augmented reality textbook features into assignments.
- Incorporating augmented reality apps into assignments that mimic real-world projects in a student's chosen field or completing assignments in collaboration with real-world organizations as part of a service-learning initiative.
- Incorporating "gamified" assignments that leverage augmented and virtual reality technologies.
- Taking virtual field trips.
- Increasing the perceived value of university programs to potential students.

CHALLENGES IN INCORPORATING AUGMENTED AND VIRTUAL REALITY INTO CLASSROOM INSTRUCTION

As previously described, augmented and virtual reality technologies have provided many possibilities for businesses in various industries. These technologies also bring new considerations for university communities. University faculty and students are currently facing challenges in several related areas, including developing and sustaining an awareness of what students need to know about these technologies in a time of fast-paced change; capitalizing on the technologies themselves by determining if and how they can enhance the classroom experience; and shaping, reporting, and disseminating the best ways to teach students about and with these technologies.

Researchers have reported that augmented reality in the classroom is not yet in practice at many universities because faculty generally do not know how to find and start using the available technology (Lee, 2012; Ramirez, 2015). Others have named the lack of research on the effectiveness of incorporating augmented and virtual reality into classroom instruction as a hindrance to faculty ability to commit to the practice (Educause, 2017). Essentially, faculty who are willing to try these new technologies in their courses can trust only very recent, often un-replicated findings or will have to spend time developing teaching strategies that allow them to use it effectively with their students.

Students have also described some challenges with the idea of using augmented and virtual reality technologies in class from their unique perspective. A report from Educause (2019), a nonprofit whose mission is "to advance higher education through the use of information technology" (para. 1) reported augmented and virtual reality technologies raise concerns for students about personal privacy, data security, and accessibility standards. Additionally, they point out the possibility for students to encounter intense, emotionally disturbing experiences that occur within various virtual reality systems, which they state "raises further questions about the ethical and psychological responsibilities of offering such technologies." Mayrath, Traphagan, Jarmon, Trivedi, and Resta (2010) found that students also faced challenges in understanding the available virtual reality technologies from a technical standpoint. They conducted a study to observe challenges and opportunities that exist when assignments were completed in the virtual world Second Life, and found that students required extensive training on proper use of the technology both before and during the courses. These researchers also determined that students struggled with access to the required technology, in part because they either did not have the memory space or specific system requirements to download Second Life onto their personal computers. Another challenge on the faculty side was making the technology available in the computer lab, which required lab assistants, additional training, and software downloads and maintenance, and so forth. Similarly, Miller (2014) emphasized that the learning curve for obtaining and using virtual reality equipment can be quite high even today as the technology has not quite made it into standard household equipment. He reported that new virtual reality headset users said they were more concerned about not breaking the device than learning how to use it during their first experience with the equipment. Miller also points out that while some instructors may see value in incorporating both distance education students and face-to-face students together into one virtual world for class exercises, the logistics of the equipment distribution and maintenance can be quite tedious. All of these reports highlight the complexity of implementing the technologies into a course, and refute the idea that it could be accomplished quickly and/or easily.

The time, resources, and technical knowledge needed to plan and execute a program in which faculty can introduce students to the technology needed for planned exercises involving augmented and/or virtual reality are often quite scarce (Bower et al., 2014). Miller (2014) highlighted the immense commitment that faculty must make to training when they would like to introduce new technologies to a classroom. This researcher acknowledged that faculty should be aware of and willing to commit to the many hours that will likely be spent getting ready to implement their augmented or virtual reality technologies to create a smooth process for students who will likely also be new to the practices. Similarly, Supiano (2018) reported that several universities have noted concern and frustration regarding the logistics of collaborations between instructional technologists, information technologists, and faculty that are necessary to create opportunities for students to experiment with the technology.

Present-day challenges in incorporating augmented and virtual reality technologies into classroom instruction all seem to revolve around a scarcity of resources. When exploring the feasibility of this practice, faculty are faced with many questions, including the following:

- How will the new technologies be funded?
- Who will maintain the software and equipment?
- Who will train the faculty to use the technologies?
- Who will train the students to use the technologies?
- What types of assignments and subjects are enhanced by using the technologies?
- What pedagogical methods are enhanced by using the technologies?

BEST PRACTICES IN USING AUGMENTED REALITY AND VIRTUAL REALITY IN HIGHER EDUCATION

While incorporating augmented and virtual reality into classroom instruction in higher education—especially in the social sciences—is still considered to be in an early phase, some best practices for introducing these technologies to students are emerging in the literature. Faculty who are considering the use of these technologies as well as faculty who have already implemented them into their courses could find value in reviewing what researchers have found so far as they look for the most effective ways to capitalize on the potential benefits they have to offer. Current best practices for faculty described below include intentional implementation, adapting current tools and practices, and finding creative ways to stay informed about new directions for augmented and virtual reality within one's own discipline.

The first common theme among published best practices involved assignment planning and the importance of assessing whether the technologies are a good fit for the particular situation. Ramirez (2015) offered five tips to faculty who are considering incorporating augmented reality into their classrooms. He urged faculty to contemplate the purpose or application of the exercise, and if a simulation will help expose students to concepts and scenarios that are not possible to bring into the classroom, consider a simulation. Additionally, he encouraged faculty to simplify the subject material to allow more abstract or complex subjects to be covered, keep the users in mind when designing exercises to minimize process discomfort, and try to determine ways to reuse existing resources to help the lesson. Finally, he suggested consulting with students, even in a pilot or focus group, to ensure that the idea is plausible and beneficial for both faculty and students. Jarmon et al. (2009) concluded, “The virtual world provides alternative spaces and contexts where project-based experiential learning can, in some cases, be conducted more easily” (p. 180). This focus on project-based learning can help instructors inform their decisions about which assignment types could provide a good starting point for the introduction of augmented and virtual technologies into a course or program. Additionally, this study highlighted the benefits of using virtual reality to complete a project with teams comprised of students from multiple disciplines.

Bower et al. (2014) concluded that most augmented and virtual reality apps that are readily available for student use often perform functions that the user could have performed using lower-order thinking skills such as recalling facts or performing routine calculations. These authors suggested that faculty should allow students to use these apps to perform these lower-order functions in order to free up more time to work on exercises that advance critical thinking skills and exercise their creativity to find new solutions to problems introduced in class. This could apply to a number of lower-level or introductory business and other social science courses in which students are frequently tasked with assignments that call for these lower-order thinking skills to come into play. Rizov and Rizova (2015) encouraged faculty to introduce augmented and virtual reality products and services into their instruction when the learning can be enhanced visually, as this will likely be the easiest form to the technology to implement in the foreseeable future. Faculty who typically show images on a screen or task students with researching items of visual interest are encouraged to search for an existing visual representation of the subject matter that incorporates an element of artificial intelligence for a low-cost, low-risk step toward incorporating digitized realities into their regular teaching practices.

Mayrath et al. (2010) also emphasized the importance of explaining the connection between the course learning objectives and the new technology being used to the students. They found that making this connection was an essential piece of information for the students to be able to accept and/or appreciate the time they must spend learning how to use a new system for a single course. The same study also concluded that students who are experienced “gamers” had much less of a learning curve when using virtual reality environments for the assignments. They suggest scaling the training sessions for students with substantial virtual reality gaming experience in one group and those new to the practice in another group, noting that the beginner group might need to receive assistance in a format that utilizes scaffolding techniques.

Another best practice in this area involves capitalizing on technologies and practices that have already been developed. In addition to bringing together students from multiple disciplines, virtual reality worlds can potentially bring together students from multiple countries, time zones, cultures, and global perspectives. When a faculty member in the social sciences is interested in incorporating a global element into his or her course, the virtual reality world Second Life has ready-made “islands” that are already populated by students and faculty, organized around various themes (Second Life, n.d.). A quick browse through the islands available on the platform yields opportunities for students to immerse themselves in activities designed to facilitate learning about business ethics in West England, taking field trips to learn more about entrepreneurship around the globe, and even take a tour on a horse-drawn carriage through Nonprofit Commons, where students can network with more than 150 nonprofit and social benefit organizations. Faculty are encouraged to search the platform to see if an island already exists that could serve as a bridge to helping students achieve the learning objectives for their course.

Lastly, as business faculty prepare future marketing professionals to enter the workforce, they should be encouraged to stay abreast of current interactive, augmented reality marketing trends. While the rapid changes taking place in this industry might seem daunting for a faculty member to keep up with, educators can consider using current marketing efforts as case studies in their courses. One current example is country singer Carrie Underwood’s promotion of her new album *Cry Pretty*. The album cover art features Underwood’s face made up with purple, sparkly “tears.” Her marketing team created and released a “Cry Pretty” filter for Snapchat users. The easy-to-use, popular smartphone app allows users to layer the same look onto their own image and share it for their friends to see, all the while promoting Underwood’s album at a very lost cost (Rincón, 2018). Faculty could challenge students to find and participate in the latest version of a popular augmented or virtual reality marketing campaign. This type of assignment would essentially task the students with crowdsourcing current ideas about how to implement these technologies for faculty, who in turn are staying abreast of contemporary efforts to engage consumers in this way. Scholz and Smith (2016) developed a framework to help academics communicate a structure for effective marketing using augmented reality to marketing and management students. These authors highlighted the importance of defining campaign goals, determining how the augmented reality layer will be activated for users, determining how content will be contributed, and determining how the social and physical context will be integrated. While augmented reality marketing campaigns can be quite effective, they are not simple to execute, and often require a large team of marketing and information technology professionals working together to produce a successful campaign.

Faculty are also encouraged to stay abreast of the different ways these technologies are used in their disciplines, which can extend beyond the classroom. As the technologies for augmented and virtual realities become more and more ubiquitous, some global businesses are turning to virtual job interviews to put employees in a simulated, realistic situation to see how they react to various stressors or circumstances that could likely occur in the job (Frost et al., 2008). As universities improve their efforts to track where their students move and which employers hire them after graduation, faculty have more opportunities to learn where their graduates are finding employment. If companies that hire your graduates use augmented and virtual reality environmental testing as part of their hiring process, it is recommended that faculty help prepare students for this practice. Campus offices that support student career services could be an excellent resource to collaborate on such an endeavor.

CONCLUSION

Bower et al. (2014) also recognized that since the usage of augmented and virtual reality in classroom instruction in higher education is such a new concept, the literature on how these products perform pedagogically is relatively unknown. These authors encourage faculty to try using these new technologies in their courses and publish information about their experiences as faculty around the globe continue to discover new uses for artificial intelligence in many academic disciplines. As described throughout this chapter, augmented and virtual realities have rapidly advanced in recent years and continue to make waves in various industries—including higher education. While the full scope of challenges and opportunities will likely not be realized for years to come, educators can help students prepare to enter the workforce in this time of high-speed technological change by devoting time and energy to exploring the possible affordances that these new technologies can bring to the student experience.

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beyond the usual textbook approach, intended to train to the test. The main elements of his approach include the partial abandonment of traditional instruction and instructor-centered roles, the design of problems derived from actual situations that have been tailored for a classroom context, and inducing the students to search for their own answers to problems appropriately presented to be both thought provoking and of contemporary relevance.

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