

Preparing for Information Technology Education in the Fourth Industrial Revolution

Maria Visitacion N. Gumabay, DIT
St. Paul University Philippines
gumabayvc@gmail.com

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Abstract:

Curriculum and Instruction for Information Technology Education plays a vital impact on students' specialized skills development to meet the demands of the technology related-innovations for the fourth industrial revolution (4IR). The identified innovations to enhance productivity are artificial intelligence (AI), internet of things (IoT), virtual and augmented realities, big data, advanced materials and nano-materials, energy capture, storage and transmission, new computing technologies. The research aims to determine the preparedness of the Philippines on the instructional requirements for Information Technology curriculum and instruction in the 4IR. The study employed a qualitative approach using descriptive research design and substantiated literature sources in collecting and analyzing the data. It was found out that the Higher Education Institution participants are somewhat ready for the implementation of the 4IR. However, there is a need to revisit the existing curriculum to meet the demands of the global economy as regard to the rapid development of technology though the implementation of the 4IR. There is also a need to incorporate in the curriculum the competencies for courses such artificial intelligence, robotics, augmented reality to Information Technology (IT) and Information System programs and deepen the courses for Computer Science program to acquire relevant competencies. Moreover, continuous faculty development program on areas needed for the 4IR. It is therefore recommended to revisit and align the curriculum and instruction requirements for the fourth industrial revolution.

Keywords: Information Technology Education, Curriculum, Instruction, fourth industrial revolution core competencies

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I. Introduction

The world is changing rapidly with the advent of technology which has a great impact in business, education, health, communication, society and particularly in peoples' own social and personal life as it gradually shapes how they live and work. New technological innovations like artificial intelligence, robotics, internet of things (IOT), big data, nanotechnology, 3D printing are emerging with the possibility of having a life-changing influence on industry, economy and society.

Education is very dynamic. The educator is responsible in preparing students not only with the knowledge and understanding of the techniques but also the right skills they need in their careers and succeed at work. According to Avi Ganon (2018),

“In the recent educational landscape, the educational tools, techniques, applications and curriculum that we have been using for decades may no longer be appropriate and applicable for its purpose. Students need to appreciate and adapt the new trends in technologies and their potential disruptions to current and future job markets, recruitment and work.” The 4IR is a challenge to all educators for the reason that they need to address the international threats in job as well as the rapid increase of jobs automation such that providing a relevant education to students is very essential. Hence, the country needs to prepare for the implementation of the 4IR to stay worthwhile in the worldwide economy, thereby preparing the nationals to be globally competitive to the demands of global market. To be ready for the 4IR, World

Economic Forum (WEF) suggests countries to improve and develop their future human resources through creative and innovative seminar workshop approaches and methodologies with state-of-the-art education curricula (WEF & Kearney, 2018).

Experts believe that 4IR is a period where combination of digital, physical and biological systems are experienced. Information Technology sets the foundations for the 4IR-related manufacturing and for the emerging multi-disciplinary technologies such as AI, IOT, Robotics, virtual reality, big data, countries are changing and developing innovative curricula to improve significant skills for the human resources (Scoop, (2017); Kurdahi, et al.,(2016); Torngren, et al., (2017).

The school leaders equipped with the correct skills the opportunities; thus, countries should start addressing the impact of automation by evaluating and assessing the curriculum to “Intelligence automation” to improve and focus on STEM (science, technology, engineering and mathematics). Thus, innovative curricula have significant impact on students’ specialized skills (Carter, et al., 2016), through analyzing and comparing 4IR-relevant information technology education curriculum, the researcher aims to determine the level of readiness of the Philippines on the instructional requirements for IT curriculum and instruction in the 4IR.

Conceptual Framework

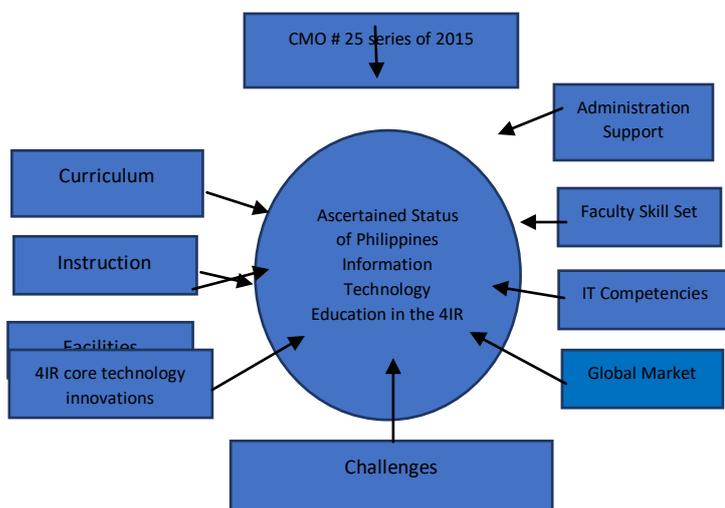


Figure 1. Concept Map of the Study

The concept map shows the relevant data in order to achieve the desired output of the study.

Statement of the Problem

1. What is the scenario of IT education in the fourth industrial revolution with respect to the following:
 - 1.1 curriculum
 - 1.2 facilities
 - 1.3 instruction?
2. What is the current status of IT education in the Region 02 in terms of the aforementioned areas?
3. What is the participants perception on the readiness of the Higher Education Institution on the instructional requirements for IT instruction in the fourth industrial revolution?
4. What are the challenges along IT instruction in the fourth industrial revolution?

II. Methodology

Research Design

This study employed a qualitative approach using descriptive research design and substantiated literature sources in collecting, analyzing the data. The interview method was utilized to collect necessary information to determine the readiness of information technology education in the fourth industrial revolution.

Participants of the study

The participants of the study were composed of five (5) deans, seven (7) program chairs and eight (8) faculty of the Information Technology programs in Region 02.

Instrumentation

In gathering the necessary data, the study used interview, and substantiated with literature review.

Interview. The study used this technique to gather significant facts and information to be utilized in the study. Interview was conducted to the Dean, Program Chairs, Faculty in the region to determine the current status of Information Technology in the Philippines in the context of their respective schools, the scenario of information technology education in the fourth industrial revolution along curriculum, facilities and instruction. It is also utilized to determine participants perception on the readiness of education as well as challenges.

Data Gathering Procedure

The researcher prepared a letter of request to gather related information, skill set and competencies of information technology education from the deans, program chairs and faculty of information technology programs in region 02. After accepting the request, the researcher conducted online interview using available online resources. Moreover, the researcher also gathered information using literature sources.

III. Results and Discussion

1. The Scenario of Information Technology Education in the fourth industrial revolution

1.1 Curriculum

Information Technology curriculum in the 4IR focuses on the rapid innovations on workforce automation in different industries world-wide. The automation applies the use of artificial intelligence (AI), and internet of things (IoT), virtual and augmented realities, big data, advanced materials and nano-materials, energy capture, storage and transmission, new computing technologies. It also geared towards interdisciplinary, project learning, and industrial practicum-based curriculum.

Information Technology curriculum is geared towards the era of combining digital, physical beginnings of the 4IR.

Bryan Edward Penprase (2018) said in his study *The Fourth Industrial Revolution and Higher Education*, substantial innovations to the science and technology curriculum will be essential to

allow students to nurture capability in the rapidly emerging areas of genomics, data science, AI, robotics and nanomaterials. He also said that a more responsive and innovative curriculum places an enormously high premium on faculty development program and curriculum enhancement, as well as the mandate to develop students who can think and prepare and shape themselves within the changing world they will graduate into.

1.2 Instruction

The 4IR had changed the way we teach and communicate with our students. Education can be delivered anywhere, anytime, place with the rapid development of technology in education. (Fisk, 2017). Learning can be taken place anytime, anyplace. e-Learning tools, applications offer countless opportunities for online, self-paced, self-directed learning and alternative learning such as flipped classroom and blended learning. Teaching and learning can also be done through class crowd sourcing and wearable assisted teaching, learning and training. Environments for learning now are characterized by virtual classrooms and laboratories, virtual libraries and virtual teachers. The need for education to be in “location-based” may diminish in some programs. The fourth industrial revolution is influenced by artificial intelligence that requires more interdisciplinary teaching and research and innovations.

1.3 Facilities

High end computer units, proprietary software for programming, robots, sensors, high speed internet connection, learning management systems are the indispensable ICT facilities needed for the delivery of curriculum and instruction.

According to Andrea Helaine (2018) in her article *The Equipment Needed for a Computer Lab*, *The Equipment Needed for a Computer Lab*, A computer lab is a classroom designed for teaching or studying. The computer lab should be designed as user friendly, convenient for teaching and learning, equipped with state-of-the-art devices and technology, secured and

reliable. She also mentioned that if the lab is to be used for video or photography production, video game programming or virtualization lessons, higher-end computers with more processing power and larger memory capacity will be required.

2. Current Status of Information Technology education

2.1 Curriculum

The curriculum of Information Technology education in the all HEI's were created based from the Commission on Higher Education Order (CMO) No. 25 series of 2015: Revised Policies, Standards and Guidelines for BSCS, BSIS and BSIT programs. The PSG is designed for all HEI's to exercise their innovativeness in the development of their curricula in the offering of BSCS, BSIT and BSIS programs (RA 7722, 1994)

The BSCS program includes the study of computing concepts and theories, algorithmic foundations and new developments in computing. The program prepares students to design and create algorithmically complex software and develop new and effective algorithms for solving computing problems. The program also includes the study of the standards and practices in Software Engineering. It prepares students to acquire skills and disciplines required for designing, writing and modifying software components, modules and applications that comprise software solution.

The BSIS program includes the study and application and effect of information technology organizations. Graduates of the program should be able to implement an information system, which considers complex technological and organizational factors affecting it. These includes components: tools, techniques, strategies, methodologies, etc.

The BSIT program includes the study of the utilization of both hardware and software technologies involving planning, installing, customizing, operating, managing and administering and maintaining information technology infrastructure that provides computing

solutions to address the needs of an organization. The minimum curriculum requirement as follows:

Courses	Number of Units
General Education	36
Common Courses	18
Professional Courses	48
Professional electives	9
Additional Math Requirements	3
PE	8
NSTP	6
Minimum total of units	146

The HEI's shall comply with the minimum requirements prescribed in the CMO # 25 series of 2015. Each HEI's may enrich the curricula with additional courses based on institutional and program goals and objectives.

Information Technology education in the region based on their experiences, it has grown beyond its usual boundaries. It is geared towards technology integration in teaching and learning. However, the status varies among the different educational institutions depending on institutional and program goals and objectives as well as the specialized track offered by HEI's.

Leading universities have more advance IT resources and tend to be the forefront of IT education innovations. However, much still needs to be done in order to remain relevant despite of the disruptive changes brought about by the 4IR.

The best practice of conducting annual curriculum review to enhance and update the curricula of studies for BSCS, BSIS and BSIT in order to uplift the information technology education in the region. Adapting technological advancement in the classroom and aggressive pursuit of industry linkages, industry immersion of faculty is important in designing innovative curriculum.

Based on the result of the interview conducted by the researcher, majority of the information technology course offerings in the region is the BSIT program. There are less than ten (10) HEI's offering BSCS while four (4) HEI's recently

applied and were granted to offer BSIS program. The most common track for the BSIT program is the Web and Mobile development. There are many tracks that can be offered in line with the demands of the 4IR to all information technology programs, however, due to limited resources. Human capital should be equipped with required skill sets and competencies for the 4IR. High-end facilities needed in the laboratory like hardware, software, internet access, other devices and the learning management system platform.

The rapid development of technology requires periodic upgrade of hardware and software used in teaching and learning.

There are different track to choose from the areas of information technology but majority of the tracks offered in the HEI's is the Programming and Web development tracks.

3. Participants' perception on the readiness of the Higher Education Institution on the instructional requirements for IT instruction in the 4IR.

a. Based on the interview, the faculty members have limited knowledge and skills on the core technology related-innovations for the 4IR such as artificial intelligence (AI), and internet of things (IoT), virtual and augmented realities, big data, advanced materials and nano-materials, energy capture, storage and transmission, new computing technologies, biotechnologies, geoen지니어ing, neurotechnology, and space technologies. Only faculty members who recently acquired their degree in Doctor in Information Technology have the knowledge and skills in data mining, data analytics, machine learning and deep learning. The rest of the faculty members in the region are not much familiar with the knowledge and application of identified core technology innovations according to WEF and Keany (2018). The following core areas are: artificial intelligence (AI), internet of things (IoT), virtual and augmented realities, big data, advanced materials and nano-materials, energy capture, storage and transmission, new computing technologies.

b. Faculty readiness in dealingwith the core technology related innovations is needed to make instruction in the 4IR possible. Hence, trainings provided to them should be sustainable so that they could fully immerse themselves on these core technologies. Also, decision makers need to be more open minded about the adaptation of new technologies and methods that suit the demands of the new digital age.

c. Moreover, the need to focus on enhancing or even re-engineering governance and education to make them more responsive to the constant change brought about by the 4IR. There is also the urgent need to close the widening gap between the digital haves and have nots.

d. Information Technology council of deans may consider involving all key stakeholders in the academic community. Government through CHED programs should be constantly revisited to ensure that necessary measures are implemented to cope up with the identified challenges.

e. With the above-mentioned concerns and time frame needed for the preparation of the curriculum and instruction, facilities, infrastructure and faculty development, majority of the HEI's in the region are not ready and well-equipped with the demands of the 4IR for ITE programs to fit the demands of global market.

4. Challenges along IT instruction in the 4IR

The fast-changing innovations and development of technologies brought both opportunities and challenges in information technology education. There are lots of job opportunities for the graduates however, those opportunities have laid challenges along information technology education. The following are the challenges:

a. Rapid update of technology

The designed curriculum and instruction before it can be implemented half of it could be obsolete already after a year. Subject matter experts are hard to find to support the needs in implementing the designed curriculum for

information technology programs. The main challenge is that the speed of innovation of technology often outpaces the delivery of up to date and relevant instruction.

b. Faculty development

Based on interview and literature review, the lack of updated faculty development on machine learning, deep learning, big data, artificial intelligence, virtual reality, augmented reality, data analytics, cyber security, cloud computing, internet of things (IoT) and robotics hinders the implementation of the 4IR in the delivery of instruction.

c. Facilities

The existing ICT equipment and facilities of most HEIs in the region are not well equipped with the requirement of the 4IR such as high-end hardware and software, high speed internet connectivity, simulation software and apps needed.

d. Curriculum, Instruction and Technology

The designed curriculum needs to be properly aligned with the call of recent 4IR.

Human capital, infrastructure, technology and instructional materials have limited budget allocation to provide the quality of education and job opportunities for the graduates

e. Industries in the Region for Faculty and Students' immersion

There are no available industries in the region where faculty and students can be exposed for training to keep-abreast to the high-speed advancement and innovations in technology

IV. Conclusion

Higher Education Institutions in Region 02 needs an insightful and in-depth preparation for curriculum, instruction and facilities to address the core competencies, values and skills of information technology education in the 4IR.

V. Recommendations

The following recommendations are presented based on the findings and conclusions of the study

1. The top-level management of HEI's may consider supporting continuously the faculty development to enhance their knowledge, skills and attitude for the 4IR.
2. The Council of Deans in Information Technology may consider re-visiting the existing curriculum and instruction of ITE programs for its enhancement.
3. HEI's regularly conduct curriculum review and actively involve the stakeholders, practitioners of 4IR, alumni, faculty and students to enhance curriculum and instruction.
4. Regular enhancement and revision of outcomes-based syllabi
5. Top management may consider full support on budget allocation on facilities, instruction and human capital.

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