TECHNIUM
SOCIAL SCIENCES JOURNAL

Vol. 19, 2021

A new decade for social changes

www.techniumscience.com

ISSN 2668-7798

Technium Social Sciences Journal
Vol. 19, 76-100, May, 2021
ISSN: 2668-7798
www.techniumscience.com

Viability of a technology-based education afterschool program

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Abstract. This research is a quantitative study that employed a descriptive research design to analyze the skillset gap by determining the level of importance of the technical skillset needed by the emerging Information Technology (IT) industry and extent of technical skills acquired by State University and Colleges' (SUCs) technology-based education programs graduating students in the Province of Iloilo. Likewise, it sought to provide baseline information in the viability of a Technology-based Education Afterschool Program (TEAP). This concept was based on the rationale that the Skills Gap Analysis and the provision of TEAP will effectively narrow down the IT skills gap. It will help SUCs' technology-based education program graduating students acquire IT industry-standard skills in robotics, computer programming, system analysis, design, web development, game development, and mobile application development. Moreover, the researcher used a descriptive design for this study, wherein an expert validated descriptive survey was developed and utilized. The researcher also established the content of this expert-approved descriptive survey instrument based on the selected sixty IT-industry skills, organized into fifteen skillsets. This survey instrument includes general questions relating to the importance level of the IT mentioned above industry skills crafted based on the viewpoints of high-level IT-industry decision-makers and SUCs technology-based graduating students. Sixty-four respondents from the IT industry who were managers/supervisors/practitioners and four hundred technology-based education graduating students of SUCs were selected using stratified random sampling. The researcher statistically treated the obtained data using the Mean, Standard Deviation, and the T- test. The Mean Difference between the Technical Skillset needed by the IT-industry in contrast to the Levels of Acquired Knowledge of the graduating students of technology-based education programs is the Skills Gap. Based on statistical inputs, the statistical findings revealed that the skillset "Knowledge in Internet-of-Things" was considered the top priority skillset needed by the IT industry. This skillset, however, is the least developed skillset of the SUCs technology-based graduating students. Therefore, "Knowledge in Internet-of-Things" earned the highest Skills Gap result amongst the fifteen IT-industry skillsets. Additionally, the T-test concluded a significant difference between the IT industry-standard technical skillset and the skillset acquired by SUCs' technology-based education programs graduating students; and that this difference is not attributed to chance. In conjunction to this, the proposed plan to address the IT skillset gap includes developing TEAP for the skillset Knowledge in Internet-of-Things, which involves skills enhancement in the development of the IoT device, Connecting IoT device to the Internet, and Programming IoT Device.

Keywords. Business Management, Skills Gap Analysis, Viability of an Afterschool Program, Technology-based Education Programs, Knowledge in Internet-of-Things, Technical Skillset

Technium Social Sciences Journal
Vol. 19, 76-100, May, 2021
ISSN: 2668-7798
www.techniumscience.com

1.0 Introduction

Information Technology (IT) professional responsibilities in the technology-based industries and organizations have expanded much over the past years (Peppard & Ward, 2016). From automation to augmentation, new technology gives advancement in new jobs, new affairs, and new industries emerging to perform further work tasks related to new technologies (World Economic Forum, 2018). Moreover, as the Fourth Industrial Revolution unfolds (Klingenberg, 2017) across the globe, the future of jobs can be expected to develop with both standard and differentiated characteristics across different countries and regions of the world (Schwab, 2016). At which point, relevant Information Technology (IT) skills are a significant pre-requisite for job seekers to succeed in the emerging global IT industry. These industry level skillsets are honed inside the classroom during a four-year study in Information Communication Technology (ICT) education using the necessary technological resources (Quisumbing et al., 2018). However, there are not enough skilled IT practitioners produced (World Economic Forum, 2018).

The technology-based industry is enduring a global crisis (Korn Ferry, 2018). Experts forecast that a vital skills deficit of 4.3 million workers by 2030 will affect the global technology sector. According to the same journal article, just like the rest of the world, Southeast Asia is not immune to this problem. Southeast Asia is likely to have an employee shortfall of between 600,000 and 1.2 million over the next 12 years due ever-expanding skills gap. Indonesia foresees a deficit of 9 million skilled and semi-skilled IT industry workers by the year 2030 while in Thailand, each year, 90% of IT graduates fail to pass the required qualifications set by IT firms for IT-related job hiring. In Philippines' IT-industry settings, although the country has enough IT graduates to fill 25% of their available IT job vacancies, 80% of the IT graduates require further preparations. In Malaysia, a whopping 90% of IT graduates need additional training before they are work-ready. And in Singapore, a small 0.8% of ICT workers can be regarded as a specialist in IT security (The American Chamber of Commerce, 2018).

Filipino ICT graduates suffer from a significant skills gap between their capabilities and what their prospective jobs require of them (Tan & Tang, 2016) – a divide that must be bridged (CARI, 2018). Skills gaps are expected to be a problem within the following industries: automation and robotics, software engineering, programming, and business industry requiring STEM education, system analysts (SMU, 2016). According to the study, both public and private schools are seen to be facing challenges in producing graduates who can meet industry standards. Asian Development Outlook 2016 (Nakao, 2016), stated that Filipino college graduates took about a year to find work while it took three years for high school graduates. It has contributed to high youth unemployment, which stands at 14 percent. As one of ASEAN's fastest-growing economies, the Philippines needs to address skills challenges (J.P. Morgan, 2016), and a key challenge is equipping graduates with industry-relevant skills, especially in sectors related to science and technology (Patacsil & Tablatin, 2017).

Based on the stated information and challenges within the context of the global, ASEAN, and Philippines skillset gap, there is a need to determine how the educational system needs to change individually on the development of a technology-based skillset to meet 21st century IT industry skills requirements (ASEAN, 2018).

Recent studies on Philippine IT skills gap include a tracer study of the BS Information Technology graduates of SY 2009-2010 to 2011-2012 of the Leyte Normal University in Tacloban City (Verecio et al., 2017) and a gap analysis exploring the importance of soft and hard skills as perceived by IT Internship students and industry (Patacsil & Tablatin, 2017). These studies defined

Technium Social Sciences Journal
Vol. 19, 76-100, May, 2021
ISSN: 2668-7798
www.techniumscience.com

the relevance of curriculum, knowledge, accomplishments, work values, and school-related factors of BS Information Technology students by IT job position of each specific locale. In other words, both studies were conducted to evaluate the employability status of the BSIT graduates of each specific region only. So far, there has never been any attempt to determine the technical skillset gap between the graduating students of technology-based education programs of State Universities and Colleges (SUC's) in the Province of Iloilo and its local IT-industry community.

2.0 Framework of the Study

This study is based on the theory that there is a gap between the IT-industry skills requirements and the skills acquired by the graduating students of technology-based education programs of SUC's and that a technology-based education afterschool program can bridge this gap. Mainly, this is about business ICT courses in today's global arena and its growing demands for a competent workforce. The advent of a massive expansion of IT has made educational institutions desire to make the graduates they produce each year to be more globally competitive, a quality that could give Filipino graduates an edge against other countries with good IT-related skills (Manyika et al., 2017).

Parsons trait and factor theory (Yunus et al., 2018) have the premise that it is attainable to assess both talents and the attributes and individual skills, necessary in a particular job. It also theorizes that workers' skills may be matched to a job that fits into them. If the ability of the individual is matched perfectly to his or her role, that individual performs best and yields the highest productivity (Shyam Nivedhan & Priyadarshini, 2018). Additionally, job-matching theory (Korn Ferry, 2018) claims that the primary goal of higher education is to equip graduates with relevant skills for future jobs. The theory affirms that a mismatch between the required skills and the acquired skills of graduates has a significant effect on their productivity. Consequently, the skills needed by industry must be equal to the acquired skills of the graduates.

The assumption that a technology-based education afterschool program has the capabilities to bridge this IT skills gap prompted the researcher to develop TEAP. The development of TEAP is anchored on the theory that surrounds development and design approaches, particularly Constructivism Theory by Vgotsky (1978 cited in Owens et al., 2018). Also, Dual Coding Theory (Paivio, 1969 cited in Mazzuca, Lugli, Benassi, Nicoletti, & Borghi, 2018) was implemented in creating the TEAP since this educational program deals simultaneously with language and with nonverbal objects and experiences. Lastly, the elements of Attention, Relevance, Confidence, and Satisfaction (ARCS) model of Motivational Design by Keller (2006 cited in Hamzah, Ali, Mohd Saman, Yusoff, & Yacob, 2015), and Activity System Theory (Engestorm, Engestorm, & Suntio, 2018) were utilized in developing and designing the technology-standard skillset training module for Robotics, Computer Programming, Systems Analysis and Technology-based Afterschool Program for Information and Communication Technology students of SUC's to cultivate an IT industry in Design, Web Development, Game Development, and Mobile Application Development. Finally, this study also utilized the Activity Systems Theory, which is a popular framework for understanding problems with the implementation of new tools into established systems of activity (Engestorm et al., 2018). Activity systems analysis can provide a framework for understanding the activities involved in university teaching.

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Vol. 19, 76-100, May, 2021
ISSN: 2668-7798
www.techniumscience.com

3.0. Methods

This study employed a descriptive design wherein a descriptive survey was developed and utilized. The said research method was chosen to provide a comprehensive and detailed analysis of the ever-expanding IT skills gap through the determination of the skillset requirements of the emerging IT industry in contrast to the acquired skillset of SUCs technology-based education program graduating students. At the entry-level, middle, and executive/leading positions in various IT firms that occupy vital and influential positions were the selected respondents for the IT-industry part. Mainly, the sought-after IT industry respondents were the selected two (2) respondents from chosen forty (40) well established IT industry firms located in the Province of Iloilo. The selection of these IT companies as respondents was based on the following criteria: a total number of employees should not be less than ten; the company is handling IT-related jobs (Programming, System Development, Web Development, Mobile Application Development, Robotics and Automation, E-Commerce); offers services relating to technology; and is a registered and legal business entity in the Province of Iloilo. In identifying the IT-industry respondents, Purposive Sample Techniques using Total Population Sampling were employed. IT industry respondents were asked to determine the level of importance of the technical skillset based on the company's needs and observations. Further, the SUCs technology-based education programs graduating students were chosen as the respondents for the IT academe part. These respondents were identified using Stratified Random Sampling. Specifically, the selected respondents were the ICT graduating class of SY 2018-2019 of Iloilo Province SUCs. These groups of respondents were chosen because the magnitude of academic skillset imparted to them was still substantial.

A researcher-made survey questionnaire was used, and subjected to content validity by top IT industry decision-makers and technology-based education deans, academic heads, professors, and educators of SUCs from Iloilo Province. These expert validators rated each content questions as 1 – "Not Necessary," 2 – "Useful but not essential" and 3 – "Essential" Then finally, the material was validated using Lawsche Content Validity Ratio (Ayre & Scally, 2014). This research instrument was further verified in terms of its reliability through Pilot Testing in the IT industry and academe respondents with reliability test using Cronbach's Alpha. The reliability test showed excellent internal consistency reliability in terms of Cronbach's Alpha value of 0.833.

Two sets of research instruments for two sets of data collection proceedings were created in this study. The first research instrument, Assessment on the IT Industry-Standard Technical Skillset Requirements (for IT Managers/Supervisors/Practitioners), allowed IT managers/supervisors/practitioners to rate the Likert type scale: 1 = "Not Important", 2= "Less Important", 3=" Important", 4= "Fairly Important", and 5 = "Extremely Important" to measure the level of importance of each skills based on IT industry requirement. This part of survey sought to answer the question, "What is the standard technical skill set needed by the emerging IT industry from the graduating students of technology-based education programs of SUCs?"

The second research instrument, Assessment on the Acquired Skillset of the Technology-based Education Program Graduating Students of SUCs allowed the respondents to rate their knowledge level on the given skills based on Likert scale: 1 = "Poor," 2= "Below Average," 3=" Average," 4= "Above Average," and 5 = "Excellent". This part of the research instrument sought to answer the question, "What is the extent of the technical skillset acquired by the graduating students of technology-based education programs of SUCs?" Subsequently, the collected data were subjected to statistical treatment, then eventually leads to Skills Gap Analysis. Average Mean was

Technium Social Sciences Journal
Vol. 19, 76-100, May, 2021
ISSN: 2668-7798
www.techniumscience.com

utilized to determine the Importance Level of IT skills based on IT Industry-Standard Technical Skillset Requirements. Average Mean was also used in determining the Levels of Acquired Skillset

Knowledge of SUCs' Technology-based Education Program graduating students. Skills Gap Analysis is the measure of the difference, and was established as the mean average difference between the levels of importance of specific technology-based skillset according to IT managers/supervisors/practitioners of an IT industry in contrast to the levels of mastery of technology-based skillset by the technology-based education program graduating students of SUC's. The more significant the mean gap value depicts, the greater the discrepancy. The t-test for independent samples was utilized to determine to mean differences in the responses of student respondents and industry representatives.

4.0 Results and Discussions

The Level of Importance of the Technical Skillset Needed by the Emerging IT Industry from the Graduating Students of Technology-based Education Programs

Table 1 displays that all skills are deemed important by IT managers, supervisors, and practitioners. An average mean range of 2.82 – 3.67 implicates that these skillsets are all required by the IT industry. Also, this table reflects that the skillset Internet-of-things received the highest mean (M=3.67, s.d.=.68) and is rated as fairly important. The rest of the skillsets scored M=2.82

– 3.36, s.d=0.31– 0.71, and are rated important by the IT managers, supervisors, and practitioners. This implies that the skillset for Internet-of-things is highly required by the IT industry than the other IT skillset.

Table 1. Level of Importance of IT Industry-Standard Technical Skillset based from the IT Industry

IT Industry-Standard Technical Skills	Mean	Importance Description	sd
1. Internet-of-things	3.67	Fairly Important	0.68
2. Cloud Computing	3.36	Important	0.57
3. Programming Languages	3.18	Important	0.32
4. Machine Learning	3.17	Important	0.42
5. Mobile App Development	3.13	Important	0.52
6. Databases	3.11	Important	0.31
7. Computer hardware	3.09	Important	0.62
8. Web Development	3.07	Important	0.27
9. E-Commerce	3.02	Important	0.33
10. Robotics	3.00	Important	0.47
11. Game Development	2.95	Important	0.61
12. Networking	2.94	Important	0.71
13. Microsoft office products	2.92	Important	0.61
14. Big Data Analytics	2.82	Important	0.66
15. System Development and Automation	2.82	Important	0.66

Note: 1.00-1.79 Not Important; 1.80-2.59 Less Important; 2.60-3.39 Important; 3.40-4.19 Fairly Important; 4.19-5.00 Extremely Important

Technium Social Sciences Journal
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"Knowledge in Internet-of-things" with the highest mean (WM=3.67) and with an interpretation of "Fairly Important" verifies several studies. For one, the World Economic Forum: The Future of Jobs Report 2018 itemized these skillsets as one of the essential IT skill sets. Based from the report, in the global industry profile of Information and Communication Technologies, IoT is one of the trends that drive industry growth, specifically the advances in computing power (World Economic Forum, 2018). Development of the IoT device, Connecting IoT device to the Internet, and Programming IoT Device can connect billions of devices capable of immediately sharing, receiving, and analyzing massive amounts of it to meet business needs better and improve decision-making (Banerjee & Sheth, 2017). Also, according to the latest research from the Business Insider, the number of IoT devices globally is assumed to have reached a total of 10 billion in year 2018 (Business Insider, cited in Hung, 2017). Researchers from the Business Insider presumed that by the year 2025, more than 64B IoT devices worldwide would flood the market.

The projected number is greater than the quantity of mobile devices currently in use all over the world. Thus, with a massive IoT market adoption now happening plus with 5G coming technology closing in, more companies are developing plans to invest heavily in IoT solutions.

On the Knowledge of Cloud Computing, which garnered a mean of 3.36 with a standard deviation of 0.57 and is rated "Important," the statistical data collected from the local IT industry projects show that Knowledge in Cloud Computing is vital skill following the trend of IoT. This event happens because cloud computing facilitates the access of applications and data from any location worldwide and any device with an internet connection. Knowledge in Cloud Computing Architecture, Cloud-based Web App Development, and Cloud-based Hardware Development is vital for the new generation of IT practitioners (Usman & Noordin, 2018).

Table 1 also establishes that based on the IT industry, Knowledge of Programming Languages is decisive third to the skills in IoT. This result appeared because a growing number of companies are demanding that their new hires should have specific technical skills in programming language (Koong, Liu, & Net, 2015). Java, Python, C++, C#, and Visual Basic are the top five programming languages that are being sought after by IT companies (Yunus, Najmuddin, & Syed, 2018). Also, IT industry reaffirms that machine learning is an essential aspect of a growing number of technologies and applications; therefore, mastery in its application in Software Development with Machine Learning Algorithm, Hardware Development Integrated with Machine Learning Algorithm, and Microsoft Azure Machine Learning is a vital skill for Industry 4.0 (Vogt, 2019).

According to the study of McKinsey (2018), other researches have highlighted the longitudinal changes in IT skills demanded by employers. As information technologies have become more sophisticated, so have employee skill levels. The ordinary IT staff member has moved beyond data processing to embrace a variety of new programming languages and paradigms, networking protocols and devices, client-server distributed computing, and other business and technology-related skills (McKinsey, 2018).

According to the report from The Internet of Things in the Power Sector Opportunities in Asia and the Pacific (Ramamurthy et al., 2017), the surge of the Internet of Things force is an outcome of the emergence of the new generation of information technology and the mobile Internet. It is of substantial significance to the development and transformation of industries in education, agriculture, business, and cities. IoT is one of the cutting-edge technologies that have high application value. IoT is a promising infrastructure and an essential engine for economic development and technological progress. IoT is for sustainable development, which makes green

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Vol. 19, 76-100, May, 2021
ISSN: 2668-7798
www.techniumscience.com

and intelligent technology. The development of the Internet-of-Things devices can play an influential role in the improvement of societies (Ramamurthy & Jain, 2017).

Furthermore, the projected demand for IoT skillset by the IT industry is an output bolstered by the government, which has been promoting smart city plans in both Manila, Iloilo, and Davao (Margolies et al., 2018). This move is anchored on the belief that city integrated in IoT can involve unified operation and city-level management of safety and security, energy, transport, education, health, environment, administration, and energy management. This thrust can nurture an exciting economic development in the Philippines that could be beneficial to community connectivity. This low power technology is a new wireless data communications standard and supported by Information and Communications Technology industry (Ramamurthy & Jain, 2017).

The Philippines thus represents a growing and less contested market with great opportunities in the IoT sector. It recently posted a GDP growth of 6.3% as well as a sustained IT spending growth of 10.1% (The American Chamber of Commerce, 2018).

Table 2 below, presents the result of the statistical survey on the specific skills needed by the IT industry. Data on Table 2 reaffirm the report from the journal "New Skills at Work: Managing Skills Challenges in ASEAN-5" that in pursuing an innovation-driven growth strategy and keeping up with the technology while dealing with the influence of disruptive technology, IT industry must focus on the latest technology offered by the following skills: Connecting IoT device to the Internet, SEO, Development of the IoT Device, Programming IoT Device, iOS Mobile IDE, C++, PHP Framework: CodeIgniter, Web Platform for Mobile Development, Cloud-based Web App. True enough - the IT industry is responding to the call for innovation to seize the market opportunities.

Table 2. Specific skills needed by the IT Industry

Industry Need skill sets	Mean	Description	SD
Connecting IoT device to the Internet	3.86	fairly important	0.81
SEO	3.75	fairly important	0.44
Development of the IoT device	3.64	fairly important	0.86
Programming IoT Device	3.52	fairly important	1.02
iOS Mobile IDE	3.44	fairly important	0.75
C++	3.41	fairly important	0.66
PHP Framework: CodeIgniter	3.41	fairly important	0.66
Web Platform for Mobile Development	3.41	fairly important	0.79
Cloud-based Web App Development	3.41	fairly important	0.66
MySQL	3.38	important	0.60
Google Analytics	3.38	important	0.60
Python	3.34	important	0.74
PHP Framework: Laravel	3.34	important	0.74
Hardware Development Integrated with Machine Learning Algorithm	3.34	important	0.74
Cloud Computing Architecture	3.34	important	0.74
Cloud-based Hardware Development	3.34	important	0.74
MS Excel	3.34	important	0.70
Operating System (OS) Installation	3.31	important	0.85

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Visual Basic	3.28	important	0.58
Software Development with Machine Learning Algorithm	3.28	important	0.58
HTML/CSS	3.25	important	0.87
MSSQL	3.25	important	0.62
eBay Seller Account	3.25	important	0.62
Unity	3.22	important	0.97
Java	3.22	important	0.74
PHP	3.22	important	0.74
Android Studio	3.22	important	0.79
Website setup in a Web Hosting	3.19	important	0.81
Oracle RDBMS	3.19	important	0.64
MIT AppInventor	3.13	important	0.83
LAN	3.09	important	1.08
Bootstrap	3.06	important	0.79
Building Robots	3.06	important	0.79
Adwords	3.06	important	0.79
Data Mining	3.00	important	0.87
Development of Web-based System Software	3.00	important	0.87
Unreal Development Kit	2.97	important	0.93
Wordpress	2.94	important	0.83
Hardware Development with Artificial Intelligence	2.94	important	0.83
Adsense	2.94	important	0.83
Assembling Computer Parts	2.88	important	0.83
IP Address Setup	2.88	important	1.06
Microsoft Azure Machine Learning	2.88	important	0.83
Network Cabling	2.84	important	0.91
Facebook Business Manager	2.84	important	0.91
Blockly	2.84	important	0.98
Data Warehousing	2.78	important	1.03
Building/Assembling Automated Device	2.78	important	1.03
Eclipse IDE	2.72	important	0.77
Javascript Framework: AngularJS	2.72	important	1.08
Javascript	2.69	important	0.92
Big Data	2.69	important	0.99
System Software Development (Desktop-based Software)	2.69	important	0.99
C#	2.66	important	0.93
Photoshop	2.66	important	0.93
Blender	2.66	important	0.89
MS Access	2.63	important	0.83
Social Media Marketing: Facebook and Twitter	2.63	important	0.83
Javascript Framework: NodeJS	2.59	Less important	1.00
MS Word	2.50	less important	0.98

Note: 1.00-1.79 Not Important; 1.80-2.59 Less Important; 2.60-3.39 Important; 3.40-4.19 Fairly Important; 4.19-5.00 Extremely Important

The Extent of the Technical Skillset acquired by the Graduating Students of Technology- based Education Programs

Table 3 below shows that the students are above average in programming languages (M=3.62, s.d.=.79) which pertain to the skillful handling of Java, Python, C++, C#, and visual basic. This implies that the technology-based graduating students have developed the fundamental knowledge in that skill, and they can apply it independently in technology-based jobs. However, in the remaining technical skillset, SUCs' technology-based graduating students' levels of knowledge are all average (M=2.73-3.38, s.d.=.69- 1.35). This statistical result implies that the technology-based graduating students can apply the specified skills but with the guidance from the IT industry managers, supervisors, or practitioners in other technical skills. This is analogous with the study of Caluza et al. (2017) that necessary trainings are needed for the improvement of knowledge of ICT.

Table 3. Level of Knowledge of SUC's Technology-based Graduating Students on IT Industry-Standard Technical Skillset

Knowledge IT Industry-Standard Technical Acquired Skills	Mean	Description	sd
1. Programming Languages	3.62	Above Average	0.79
2. Web Development	3.48	Above Average	0.86
3. Game Development	3.47	Above Average	0.64
4. Computer hardware	3.44	Above Average	1.14
5. System Development and Automation	3.4	Above Average	1.06
6. Robotics	3.38	Average	1.35
7. Big Data Analytics	3.37	Average	1.23
8. E-Commerce	3.37	Average	0.86

Technium Social Sciences Journal
Vol. 19, 76-100, May, 2021
ISSN: 2668-7798
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9. Machine Learning	3.33	Average	0.69
10. Cloud Computing	3.31	Average	0.98
11. Networking	3.29	Average	0.98
12. Microsoft office products	3.27	Average	0.88
13. Mobile App Development	3.24	Average	0.78
14. Databases	3.21	Average	0.89
15. Internet-of-things	2.73	Average	0.76

Note: 1.00-1.79 Poor; 1.80-2.59 Below Average; 2.60-3.39 Average; 3.40-4.19 Above Average;
4.19-5.00 Excellent

One of the essential skills that an IT industry employer is searching for in an IT professional, is the knowledge and ability to write program code. If the job is programming or software/web development, an employer may seek a candidate that can do programming code in different programming languages, as many systems are built using more than just one language. Table 3 indicates that the Philippines SUC's technology-based graduating students have prepared well their students in the field of programming. The above-average rating for skillset in Programming, Languages (3.62) Web Development (3.48), Game Development(3.47), Computer Hardware (3.44) and System Development and Automation (3.4) depicts that the SUC's implementation of curriculum focuses on the related subjects and is making an impact on the acquired skills of the technology-based graduating students.

However, Table 3 shows that amongst the 15 skillsets, Knowledge on the Internet-of-Things received the lowest mean. This result denotes that amongst surveyed technology-based graduating students of SUC's, Knowledge in the Internet-of-Things specifically the development of the IoT device, connecting IoT devices to the Internet, and programming IoT device is the least developed acquired skillset.

Although SUC's, specifically in technology-based education, have been trying to cope with the demands of the IT industry, SUC's are not producing enough above average skillful graduates to fill blue-collar jobs. Circumstances uncovered by Manasan and Parel (2015) tap a sad finding that sets to investigate the efficiency of SUC management and its cost in relevance to the quality of education it yields. Manasan et al. (2015) infer that the cause of the problem stretches down to SUC's and the CHED management common problems, especially where course duplication confuses a significant number of SUC's from accomplishing its core mandates efficiently. Because of the shortages of highly qualified IT professionals plus the ever-changing business environment, IT professionals are expected and required to remain on the cutting edge of technological advancements (Frey, Osborne, & Citi Research, 2015). A majority of universities and colleges in the Southeast Asia region fall short of providing the appropriate curriculum that equips the BSIT graduates with above-average industry-related skills and standards (UNESCO Institute for Statistics, 2014) which might impede or put a setback on maximizing their potential on achieving an excellent technical skill set for the IT industry.

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Vol. 19, 76-100, May, 2021
ISSN: 2668-7798
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The Philippines is behind in terms of the technology of well-developed countries such as the USA, European Countries, Singapore, Japan, China, and other Asian countries (OECD Development Centre, 2018). Therefore, the Philippines requires increasing the number of well-trained and highly skillful IT people and programmers to develop advanced technologies to narrow the gap and to leapfrog the technology industry (UNCTAD, 2018).

Article I. Technology-based Graduating Students Acquired Skills

Data on Table 4 below confirm that the educational programs of SUC's have equippedthe students with the essential ability to conceptualize, design, and implement software applications. The subjects in PHP, Javascript, Visual Basic, Python, Unity, Cloud-based Web App Development, Development of Web-based System Software, Bootstrap, Adwords, Network Cabling, Java, HTML/CSS, C++, Web Platform for Mobile Development, Facebook Business Manager, Data Warehousing, Building Robots, and Photoshop prepared students to be tech professionals who are able to perform installation, operation, development, maintenance, and administration of computer applications. However, the statistical result also presents that the technology-based programs of SUC's have failed to respond to the IoT industry demands wherein the skill in connecting IoT device to the Internet (which is a demand skill) received only a mean of score of 2.41, s.d=1.03 and rated as below average.

Table 4. Technology-based Graduating Students Acquired Skills

Students' Specific Skills	Mean	Description	SD
PHP	4.04	above average	1.13
Javascript	3.96	above average	1.10
Visual Basic	3.84	above average	1.18
Python	3.82	above average	1.19
Unity	3.73	above average	0.73
Cloud-based Web App Development	3.64	above average	1.20
Development of Web-based System Software	3.64	above average	1.19
Bootstrap	3.63	above average	1.20
Adwords	3.62	above average	1.20
Network Cabling	3.61	above average	1.20
Java	3.57	above average	1.20
HTML/CSS	3.56	above average	1.15
C++	3.54	above average	1.38
Web Platform for Mobile Development	3.54	above average	0.95
Facebook Business Manager	3.53	above average	0.97
Data Warehousing	3.52	above average	1.53
Building Robots	3.51	above average	1.54
Photoshop	3.49	above average	1.54
Social Media Marketing: Facebook and Twitter	3.49	above average	1.54
MS Word	3.48	above average	1.03
Hardware Development Integrated with Machine Learning Algorithm	3.48	above average	1.03

Technium Social Sciences Journal
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ISSN: 2668-7798
www.techniumscience.com

Javascript Framework: AngularJS	3.47	above average	1.42
Software Development with Machine Learning Algorithm	3.47	above average	0.91
Eclipse IDE	3.46	above average	1.07
Operating System (OS) Installation	3.44	above average	1.34
Assembling Computer Parts	3.43	above average	1.24
MSSQL	3.43	above average	1.13
Javascript Framework: NodeJS	3.40	above average	1.31
PHP Framework: Laravel	3.40	above average	1.44
Unreal Development Kit	3.36	average	0.93
C#	3.33	average	1.29
Data Mining	3.32	average	1.37
Blender	3.31	average	0.97
System Software Development (Desktop-based Software)	3.30	average	1.36
eBay Seller Account	3.30	average	1.36
Website setup in a Web Hosting	3.29	average	1.36
Big Data	3.29	average	1.44
iOS Mobile IDE	3.29	average	1.26
Cloud Computing Architecture	3.27	average	1.34
Building/Assembling Automated Device	3.27	average	1.34
Oracle RDBMS	3.27	average	1.01
PHP Framework: CodeIgniter	3.26	average	1.43
Wordpress	3.26	average	1.34
Hardware Development with Artificial Intelligence	3.26	average	1.44
Adsense	3.26	average	1.34
LAN	3.26	average	1.34
Blockly	3.23	average	1.03
MS Access	3.22	average	1.32
Programming IoT Device	3.14	average	0.98
MS Excel	3.07	average	1.03
Microsoft Azure Machine Learning	3.05	average	1.03
SEO	3.04	average	1.48
IP Address Setup	3.02	average	1.48
Cloud-based Hardware Development	3.02	average	1.49
Google Analytics	3.01	average	1.48
Android Studio	3.00	average	1.45
MIT AppInventor	2.96	average	1.09
MySQL	2.95	average	1.13
Development of the IoT device	2.66	average	1.14
Connecting IoT device to the Internet	2.41	below average	1.03

Note: 1.00-1.79 Poor; 1.80-2.59 Below Average; 2.60-3.39 Average; 3.40-4.19 Above Average;

4.19-5.00 Excellent

Technium Social Sciences Journal
Vol. 19, 76-100, May, 2021
ISSN: 2668-7798
www.techniumscience.com

Skillset Gap—difference between the Technical Skillset needed by the Industry and Skills acquired by the Graduating Students of a Technological-Based Education Program

Table 5 below shows that the most significant gap that can be observed is in the skill of Internet-of-Things (IoT) with a gap of .94, which refers to the skills needed in the development and application of (IoT) device.

Table 5. t-test results for the difference between the Technical Skills needed by the Industry and acquired by Graduating Students

	Importance mean	Knowledge	mean difference	t-ratio	t-sig
Knowledge of programming languages	3.18	3.62	-0.440	-7.707	0.000*
Knowledge of web development	3.07	3.48	-0.410	-7.615	0.000*
Knowledge of computer hardware	3.10	3.44	-0.340	-3.533	0.001*
Knowledge of databases	3.11	3.22	-0.110	-1.776	0.077
Knowledge of Networking	2.94	3.29	-0.350	-3.513	0.001*
Knowledge of standard software applications (Microsoft Office products)	2.92	3.27	-0.350	-4.003	0.000*
Knowledge in Big Data Analytics	2.82	3.37	-0.550	-5.374	0.000*
Knowledge in Mobile App Development	3.12	3.24	-0.120	-1.576	0.118
Knowledge in Game Development	2.95	3.47	-0.520	-6.229	0.000*
Knowledge in Internet-of-things	3.67	2.73	0.940	10.025	0.000*
Knowledge in Machine Learning	3.17	3.33	-0.160	-2.543	0.012*

Knowledge in Cloud Computing	3.36	3.31	0.050	0.648	0.518
Knowledge in Robotics	3.00	3.38	-0.380	-4.264	0.000*
Knowledge in System Development and Automation	2.82	3.40	-0.580	-5.917	0.000*
E-Commerce	3.02	3.37	-0.350	-5.890	0.000*

*P<0.05 significant at 0.05 alpha

The depicted statistical outcome, as projected in Table 5, confirms the economic report "Future Technologies for Smart Cities" by Kamolov et al. (2018). The author argues that the organizations are itching to start internet of things initiatives, but it is hampered because of the shortage of skills (Kamolov & Korneyeva, 2018).

According to The Adecco Group, Southeast Asia is presently facing a growing skillset gap amidst strong growth in business investments (The ADECCO Group, 2017). Southeast Asia faces a labor pool crunch in various sectors, particularly in information technology, healthcare, digital, analytics, robotics, and automation. Moreover, skilled employees in the region are much less mobile than their counterparts abroad (OECD Development Center, 2018). Countries in Southeast Asia need greater cooperation between governments, academia, and businesses to ensure that academic institutions are teaching the right skills required for the workplace (UNOSSC, 2018). One of the main challenges confronting the ASEAN nations with concerns about the skills gap is the effect of disruptive technologies (ACT/EMP, 2018).

An empirical investigation determined how accurately IT students view the IT technical skills as an essential requirement to be a successful IT expert and how well their opinions match those IT technical skills sought in IT online job advertisements. Moreover, the authors found that several gaps exist between student perceptions of the skills they need versus the actual IT skills employers are advertising (Medlin et al., 2007 cited in Patacsil & Tablatin, 2017).

Table 5 reveals a significant difference in the industry needs according to students' skill set when classified as to knowledge in Internet-of-things, t=10.025, p=0.000. This result shows that the students' skills are not enough at the requirements of the industry. Other skillset also reveals a significant difference in the IT industry-standard technical skillset and the skillset acquired by the graduating students of technology-based education programs of SUC's, t=-7.701 – -2.543, p=0.000

– 0.012. Meaning, the students' skillset is sufficient in terms of the requirements of the industry.

Furthermore, findinsgs revelas that there is no significant difference in the industry needs according to students' skill set when classified as to knowledge in database, mobile app development, and in cloud computing, t=-0.12 – 0.05, p=0.077 – .518.

Schirf and Serapiglia (2017) found that every year, several survey records are conducted throughout the IT industry by different research groups and trade magazines to attempt to measure the state of the industry as it correlates to technology trends. Accordingly, the results showed that the "skills" gap is not just technical. The soft skills of motivation and positive attitude, communication, interpersonal skills, and problem-solving are more in demand than a specific hard skill of programming languages or other CS/IT specific training (Schirf & Serapiglia, 2017).

Added to this, Liu et al. (2014) have concluded that the Philippines, together with India, and China, are among the countries in Southeast Asia that causes an influx of low-skilled

workers because of poor quality and relevance of education. The authors further concluded that academic education and Technical and Vocational Education and Training (TVET) track programs are facing some difficulties concerning meeting the training needs of new entrants in the emerging and global markets.

The Proposed Plan to address the Skills Gap between IT Industry Standard Skillset and the Acquired Technical Skillset by Graduating Students of the Technology-based Education Programs of SUC's

Based from the results of the study, the skills on the Knowledge on Internet-of-Thing such as Development of the IoT device, Connecting IoT device to the Internet, and Programming IoT Device are among the IT expertise that have the most significant mean difference gap between the IT industry standard skillset and the acquired technical skillset by the graduating students of the technology-based education programs of SUC's. Therefore, a Technology-Based Education Afterschool Program (TEAP) courseware for skills enhancement of Knowledge on Internet-of- Thing such as Development of the IoT device, Connecting IoT device to the Internet, and Programming IoT Device should be developed, and a feasibility study for this program should be composed.

Internet-of-Things Courseware: A Technology-Based Education Afterschool Program (TEAP) for Skills Enhancement in Internet-Of-Things is a ready-to-teach package that is designed and developed to equip technology-based graduating students with the knowledge and skills on how to design and build an embedded system with IoT capabilities. The primary intent of this educational program is to enhance the skills of the graduating students of technology-based education programs of State Universities and Colleges (SUC's), specifically on the development and deployment of IoT devices. This courseware covers fundamental IoT concepts and hands-on activities that supports the students' IT skills development. The concerned major IoT topics are IoT Fundamental Concepts, Development of the IoT device, Connecting an IoT device to the Internet, and Programming IoT Devices. The knowledge and enhanced skills derived from the courseware can fill in the gap between the IT industry standard skillset and the acquired technical skillset by graduating students of SUC's.

This is based on the rationale that a feasibility can lead to the successful implementation of the afterschool program which in turn can help students develop industry-standard skills, build a strong foundation for advanced IT certifications with linkages to local and international industries (for example: CISCO, PROXOR, Microsoft Academy, ORACLE, IBM-DB, SAP, TOON CITY, and W3SCHOOLS), improve responsiveness to government training programs (for example: TESDA-TVET IT track programs), improve training and assessment for knowledge in internet-of-things skills, and adapt to the trends in IT the industry.

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