

Computer Engineering Curriculum Needs Assessment: As Perceived By Industries In Zamboanga City

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ABSTRACT

This study explored Zamboanga City industries' needs regarding the technical and non-technical skills that computer engineering graduates should possess. The results also served as inputs to redesign the Bachelor of Science in Computer Engineering (BSCpE) curriculum of Western Mindanao State University (WMSU) to avoid job mismatch. A descriptive-quantitative study was conducted among Information and Communications Technology (ICT) heads of different private and public industries in Zamboanga City through a survey questionnaire. The results revealed that it is vital for computer engineering graduates to possess technical skills such as software development, system and network administration, entrepreneurship, and non-technical skills. The private and public sectors also listed other skills that are very important for computer engineering graduates to have. These include demonstrating SQL knowledge, configuring, managing, and maintaining servers, pitching business ideas, and managing stress. The findings also showed that compared with the private sector, the public sector considers software development and system and network administration skills to be very important for computer engineering graduates. Moreover, the private sector's needs in terms of technical skills have a significant difference from the public sector's needs, except for entrepreneurship. Overall, industries in Zamboanga City recommended system and network administration and software development skills to emphasize the BSCpE curriculum design.

Keywords

computer engineering, curriculum, job mismatch, non-technical skills, technical skills

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Introduction

The employability of graduates in their chosen field is an indication that Higher Education Institutions (HEIs) can prepare their students to work in different industries. These institutions aim to produce skilled graduates and, more importantly, equipped to meet the industry's demands. Unfortunately, it is observed that some of the graduates do not land on a job that is relevant to the degree they have earned. This issue is termed as "Job Mismatch," which is defined as the imbalance between the business demands and the pool of talented workforce (Orillaza, as cited in Enguerra, 2016). Many of the graduates would later realize that their skills do not match the industry's jobs. So they tend to apply for other jobs, which in many cases are not relevant to their degree, for as long as it offers them secured employability. Other graduates whose skills meet the industry's demands also find it hard to get a job related to their course because there are limited posts available. For this reason, graduates become content with any job they can get if it allows them to earn enough for their living.

To solve job mismatch, HEIs would collaborate with industry partners to determine their needs

and find a way to integrate those needs into the curriculum (Laguador & Ramos Jr., 2014). Both the government and the private sector can contribute to the development of a curriculum. To help achieve local and national development goals, a collaboration between HEIs and the government is essential (Mariñas & Ditapat, n.d.). This ensures that graduates possess skills that can help uplift the economy, especially in the Philippines. Often, the government would also discuss with HEIs about encouraging students to work on a research or project that aims to help communities. Therefore, these industries' inputs are essential in the design, development, or revision of a curriculum, which shall prepare graduates for their future employment.

In WMSU, one of the College of Engineering and Technology (CET)'s nine (9) engineering programs is the Bachelor of Science in Computer Engineering (BSCpE). There are five (5) tracks specified in the Draft Commission on Higher Education (CHED) Memorandum Order dated November 3, 2016, for BSCpE, and these include Microelectronics, Embedded Systems, Software Development, System and Network Administration, and Technopreneurship. These tracks give students an idea of the type of job they

will have after graduation. In general, BSCpE graduates are known to be working in companies or industries that involve computers in their operations. Zamboanga City is a highly urbanized city located on the island of Mindanao, Philippines. It has an international airport and seaport, schools, hospitals, shopping malls, and government offices. In Zamboanga City, BSCpE graduates are employed in various workplaces: transportation, education, commercial sectors, and government offices. Despite the former, it is still observed that some BSCpE graduates are not able to find a relevant job in Zamboanga City. Only a few work in the software development industry while others fall in irrelevant fields to their course. This fact may probably explain why only a small number of students take an interest in enrolling in the BSCpE course despite the effort taken in promoting the program.

The department needs to re-evaluate its curriculum to determine if the program produces graduates whose skills meet industries' demands in Zamboanga City to address job mismatch. This study aimed to determine the needs of the various sectors in the city and help the Department of Computer Engineering of WMSU enhance, revise, or redesign its BSCpE curriculum. This research is also significant to the WMSU administration and the CET, realizing the importance of collaboration with the industry in designing a curriculum. With this, the administration can even think of the facilities and equipment that the BSCpE program needs to effectively prepare students to become skilled and ready to work in the industry.

This study aimed to answer the following questions:

1. What are the technical skills needed in the BSCpE curriculum as perceived by the industries in Zamboanga City?
2. What are non-technical skills defined in the Draft CMO that are important for a BSCpE graduate to possess?
3. What are other skills specified by industries in Zamboanga City that are important for BSCpE graduates to possess?
4. Is there a significant difference in the needs of industries in Zamboanga City when data are grouped according to sector?

Methods

This study employed a descriptive-quantitative design. It is descriptive because the researcher intended to describe the technical and non-technical skills that BSCpE graduates should have according to industries. Moreover, quantitative analysis was utilized to determine the level of importance of technical and non-technical skills and if there is a significant difference in industries' needs. The respondents of this research were industries in Zamboanga City, Philippines. Only industries that involved Management Information Systems (MIS) and other computer engineering fields in their operations were considered respondents. The respondents were then grouped according to private and public sectors and were selected using purposive sampling.

The researcher utilized a self-made survey questionnaire. The questionnaire consisted of three (3) parts, which evaluated software development, system and network administration, technopreneurship, and non-technical skills. The respondents rated these skills based on a Likert scale, according to how they consider each skill as important for computer engineering graduates to possess. The respondents were also encouraged to list any skill (not included in the list) that they know or think is important for BSCpE graduates to have.

The survey questionnaire was then subjected to content validity by the panel of experts. These experts have a degree of Master of Science in Computer Science (MSCS) and Master of Engineering in Electronics and Communications Engineering (MEngECE). There was no expert with a master's degree in computer engineering to validate the instrument. It was resolved, however, to experts with master's degrees in allied fields of BSCpE. Revisions were made based on the recommendations and suggestions of the experts.

Statistical tools were also used to analyze and interpret the results of the survey. These statistical tools include frequency distribution, weighted mean, and range. Independent samples t-test was also used to answer the research question no. 4.

Results, Discussions, and Conclusions

This chapter presents, interprets, and analyzes data gathered from a total of 52 respondents representing offices and companies that use MIS or involve other fields of computer engineering specialization in their operations such as software development, system and network administration, and technopreneurship.

A survey questionnaire was given to ICT heads of each office or company, and out of 57 respondents, 52 respondents answered and returned the survey questionnaire. Some companies and offices that use MIS or involve other fields of computer engineering specialization in their operations but whose IT departments are based in Manila or other locations outside Zamboanga City were not considered respondents of this study. Also, other offices and companies decided not to answer the survey questionnaires citing confidentiality as a reason. Finally, some respondents failed to return the survey questionnaires despite constant follow-ups through phone calls and in-person inquiries. Reasons for survey questionnaire retrieval failure include disapproval from heads of offices or companies to participate in this study, and ICT heads reasoning no time to answer the survey questionnaire due to their busy schedules. Nevertheless, the majority of the respondents were able to respond and return the survey questionnaires.

Table 1: Number of Companies Under Private and Public Sectors based on the Computer Engineering Specializations

Computer Engineering Specialization	No. of Companies in Private Sector	No. of Companies in Public Sector
<i>Software Development</i>	16	19
<i>System and Network Administration</i>	22	26
<i>Technopreneurship</i>	11	10

The table above shows the total number of companies under the private sector that involve computer engineering specialization in their operations, or they intend to have in the future, namely Software Development, System and Network Administration, and Technopreneurship. Sixteen (16) out of 25 or 64% of the private companies have said that they involve Software Development in their operations, 22 out of 25 or 88% of the private companies have said that they involve System and Network Administration, while 11 or 44% of the total number of private companies have said that Technopreneurship is involved in their company. This further emphasizes that most private companies deal with the System and Network Administration.

The previous table also exhibits the total number of companies under the public sector that involve computer engineering specialization in their operations, or they intend to have in the future. It clearly shows that most of the public sector deals with system and network administration. Based on some information given by the respondents, most offices use off-the-shelf systems, so they do not develop software, and their IT departments or MIS office does only system and network administration. Off-the-shelf systems are software applications available for sale from a store. This software is not specially designed or custom-made for an office.

Also, based on the results shown in Table 1, it is evident that most companies in both private and public sectors hire computer engineering graduates to manage their systems and networks. This indicates that HEIs offering BS Computer Engineering in Zamboanga City should give more emphasis on courses that focus on System and Network Administration. Nevertheless, a good number of companies and offices in both private and public sectors hire computer engineering graduates to develop software while some also deal with Technopreneurship.

The following sections will answer the questions that this research aimed to find out.

What are the technical skills needed in the BSCpE curriculum as perceived by the industries in Zamboanga City?

The following results show the perceptions of industries in Zamboanga City in terms of the

technical skills needed in the BSCpE curriculum. Both the private and public sectors rated how important these technical skills are for BSCpE

graduates to possess, namely software development, system and network administration, and technopreneurship skills.

Table 2: Level of Importance of Software Development Skills by Sector

Software Development Skills	Private Sector		Public Sector		Grand Mean	Interpretation
	Mean	Interpretation	Mean	Interpretation		
1. <i>Acquire proficiency in algorithm development using a high-level programming language</i>	4.38	<i>Very Important</i>	4.74	<i>Very Important</i>	4.56	<i>Very Important</i>
2. <i>Apply object-oriented analysis and design to solve engineering problems</i>	3.94	<i>Important</i>	4.58	<i>Very Important</i>	4.26	<i>Very Important</i>
3. <i>Translate requirements into system models</i>	4.25	<i>Very Important</i>	4.74	<i>Very Important</i>	4.50	<i>Very Important</i>
4. <i>Develop graphical user interfaces</i>	3.88	<i>Important</i>	4.53	<i>Very Important</i>	4.20	<i>Important</i>
5. <i>Apply principles of human computer interaction in the design of computer interfaces</i>	4.00	<i>Important</i>	4.58	<i>Very Important</i>	4.29	<i>Very Important</i>
6. <i>Apply best practices in coding software</i>	4.19	<i>Important</i>	4.79	<i>Very Important</i>	4.49	<i>Very Important</i>
7. <i>Understand and manage projects effectively</i>	4.38	<i>Very Important</i>	4.84	<i>Very Important</i>	4.61	<i>Very Important</i>
ALL	4.15	Important	4.69	Very Important	4.42	Very Important
Legend: 4.21-5.00 Very Important 3.41-4.20 Important 2.61-3.40 Moderately Important 1.81-2.60 Slightly Important 1.00-1.80 Not Important						

The previous table shows the level of importance of software development skills for computer engineering graduates to possess. Based on the results, the following skills were rated the highest by the private sector with a mean of 4.38 and 4.25, interpreted as *Very Important*. These include the ability to *acquire proficiency in algorithm development using a high-level programming language*, *translate requirements into system models*, and *understand and manage projects effectively*. The rating mentioned above implies that the private sector wants BSCpE graduates to demonstrate software development knowledge, including algorithm development, prototyping, and project management. Other software

development skills shown in the preceding table were rated *Important* by the private sector. These skills emphasize system design and implementation. One of the reasons why these skills were rated only *Important* by the private sector is that most private companies in Zamboanga City do not develop their software; instead, they purchase it from software development companies. The job of BSCpE graduates in their company is only to deploy and maintain bought systems. It was also noted that an overall mean of 4.15 was obtained from the private sector, with an interpretation of *Important*. This indicates that the private sector considers the

presented list of software development skills as essential for BSCpE graduates.

Moreover, the previous table also shows the means and their corresponding interpretation based on how the public sector rated each software development skill. It was noted that all software development skills were rated *Very Important* by the public sector. An overall mean of 4.69 was obtained, with a corresponding interpretation of *Very Important*. This implies that the public sector considers all the presented software development skills as very important for BSCpE graduates to possess. This is considering that most of the public offices would hire BSCpE graduates to develop software for their offices to support their operations.

Furthermore, it was observed that both sectors rated software development skill nos. 1, 3, and 7 as the highest with a grand mean of 4.56, 4.50, and 4.61, respectively, and an interpretation of

Very Important. Software development projects are handled by programmers, system analysts, test engineers, and training and project managers. The success of managing software development projects results from how these people collaborate to produce quality software. However, the skill to *develop graphical user interfaces* was rated as *Important* only. A graphical user interface allows users to interact with the computer. The rating given by both private and public sectors to software development skill no. 4 further implies that industries may already assume that once BSCpE graduates are competent in developing software, they are also proficient in designing graphical user interfaces.

Nevertheless, the results revealed that both the private and public sectors rated most software development skills, with a grand mean of 4.42, as *Very Important* to be included in the BSCpE curriculum.

Table 3: Level of Importance of System and Network Administration Skills by Sector

System and Network Administration Skills	Private Sector		Public Sector		Grand Mean	Interpretation
	Mean	Interpretation	Mean	Interpretation		
1. Troubleshoot PC hardware and configure routers	4.55	Very Important	4.85	Very Important	4.70	Very Important
2. Identify and appreciate different applications and types of computer communication networks	4.36	Very Important	4.52	Very Important	4.44	Very Important
3. Understand and describe the concept and functionality of each layer in the OSI reference model for open systems interconnection	4.05	Important	4.58	Very Important	4.32	Very Important
4. Describe the different topologies, transmission media, and access control methods commonly used in wired local area networks	4.23	Very Important	4.50	Very Important	4.37	Very Important
5. Understand the technological issues and operational characteristics associated with wireless LANs	4.32	Very Important	4.65	Very Important	4.49	Very Important
6. Install and configure Linux and Windows servers	4.23	Very Important	4.42	Very Important	4.33	Very Important
7. Apply the different aspects of	4.27	Very	4.77	Very	4.52	Very

<i>network administration, its management and security</i>	<i>Important</i>	<i>Important</i>	<i>Important</i>
ALL	4.29	4.61	4.45
	Very Important	Very Important	Very Important
Legend: 4.21-5.00 Very Important 1.81-2.60 Slightly Important	3.41-4.20 Important 1.00-1.80 Not Important	2.61-3.40 Moderately Important	

The preceding table shows the computed mean and equivalent verbal interpretation for each system and network administration skills rated by private and public companies and offices. The results show that all system and network administration skills were rated *Very Important* by the private sector except for system and network administration skill no. 3, which is to *understand and describe each layer's concept and functionality in the OSI reference model for open systems interconnection*. A mean of 4.05 was obtained, with an interpretation of *Important*. The International Standards Organization (ISO) developed the Open Systems Interconnection (OSI) model. One of the possible reasons why the private sector rated system and network administration skill no. 3 as only *Important* is because they might be using other reference models, which is the Transmission Control Protocol/Internet Protocol (TCP/IP) reference

model in their facilities. Nevertheless, an overall mean of 4.29 was obtained from the private sector, with an interpretation of *Very Important*. This indicates that the private sector considers the list of system and network administration skills as *Very Important*.

The results also revealed that the public sector considers all system and network administration skills as *Very Important* for BSCpE graduates to possess. An overall mean of 4.61 was obtained, with an interpretation of *Very Important*. Moreover, a grand mean of 4.45 was obtained from private and public sectors, with an interpretation of *Very Important*. This indicates that both sectors consider system and network administration skills as *Very Important* for BSCpE graduates to possess. It is evident in Table 3 that System and Network Administration is the computer engineering specialization that is most needed by industries in Zamboanga City.

Table 4: Level of Importance of Technopreneurship Skills by Sector

Technopreneurship Skills	Private Sector		Public Sector		Grand Mean	Interpretation
	Mean	Interpretation	Mean	Interpretation		
1. Have the knowledge in innovation and entrepreneurship including key processes in introducing products and services to the market	3.82	Important	3.90	Important	3.86	Important
2. Create and assess business ideas	3.91	Important	3.80	Important	3.86	Important
3. Demonstrate the awareness of marketing strategies	3.80	Important	3.78	Important	3.79	Important
4. Create a viable business plan including market analysis, sales forecast, financial projections, as well as business model and	4.00	Important	3.80	Important	3.90	Important

strategy						
5. Develop new skills and acquire knowledge on innovation that will enhance their ability to contribute to the long-term competitiveness of businesses	4.00	Important	4.40	Very Important	4.20	Important
6. Apply management and information system competencies and construct scientific paper related to technopreneurship	4.00	Important	4.30	Very Important	4.15	Important
ALL	3.92	Important	3.99	Important	3.96	Important
Legend: 4.21-5.00 Very Important 3.41-4.20 Important 2.61-3.40 Moderately Important 1.81-2.60 Slightly Important 1.00-1.80 Not Important						

Table 4 exhibits the computed weighted mean and its equivalent verbal interpretation for each technopreneurship skill rated by private and public sectors. The results show that all technopreneurship skills were rated as *Important* by the private sector. BSCpE graduates are expected to know about product innovation and entrepreneurship. Technopreneurship skill nos. 4, 5, and 6 were rated the highest with a mean of 4.00, and an interpretation of *Important*. Technopreneurship skill nos. 2, 1, and 3 were rated next to highest with a mean of 3.91, 3.82, and 3.80, respectively, but still with an interpretation of *Important*. It is observed that the private sector rated technopreneurship skills comparatively low with other technical skills. This is probably because the private companies would hire BSCpE graduates to focus on their computer's technicalities rather than help them do their business. Nevertheless, an overall mean of 3.92 was obtained, with an interpretation of *Important*. This signifies that technopreneurship skills were still considered necessary for BSCpE graduates to possess according to the private sector.

The previous table also shows the ratings of the public sector for each technopreneurship skill. It was noted in Table 1 that ten public offices have said that they involve technopreneurship in their operations. These public offices consider technopreneurship skill nos. 5 and 6 as *Very Important* with a mean of 4.40 and 4.30, respectively. The public sector agrees that it is vital for BSCpE graduates to demonstrate

knowledge in innovation that will further enhance their ability to contribute to a business's long-term competitiveness. Though most public offices do not deal with doing business, they still consider innovating things as very important for BSCpE graduates to possess. Government offices such as the Department of Science and Technology (DOST) and the Department of Trade and Industry (DTI) collaborate with HEIs to encourage students to innovate things and find possible investors for their innovations. This skill is encouraged because innovations are seen as potential, especially in addressing society's problems. These innovations would aim to help alleviate the lives of people in the community. Moreover, BSCpE graduates need to demonstrate the ability to apply management and information system competencies and construct scientific papers related to technopreneurship. Scientific reports, feasibility studies, and other technical documents are some of the essential aspects of technopreneurship. Technopreneurship as a subject teaches BSCpE students to document their innovations, which serve as business proposals to market their innovations to potential investors. Furthermore, the overall computed mean for technopreneurship skills rated by the public sector was 3.99, interpreted as *Important*. This implies that technopreneurship skills are important for BSCpE graduates to possess.

Finally, a grand mean of 3.96 was obtained, with an interpretation of *Important*, and further indicates that both private and public sectors

consider technopreneurship skills as necessary for BSCpE graduates to have, even if their offices do not primarily deal with technopreneurship.

The following table shows the perceptions of industries in Zamboanga City in terms of non-technical skills needed in the BSCpE curriculum. Both private and public sectors rated how important these non-technical skills are for BSCpE graduates to possess.

What are non-technical skills defined in the Draft CMO that are important for a BSCpE graduate to possess?

Table 5: Level of Importance of Non-Technical Skills by Sector

Non-Technical Skills	Private Sector		Public Sector		Grand Mean	Interpretation
	Mean	Interpretation	Mean	Interpretation		
1. Work effectively on multidisciplinary and multi-cultural teams	4.41	Very Important	4.60	Very Important	4.51	Very Important
2. Have an understanding on professional and ethical responsibility	4.55	Very Important	4.68	Very Important	4.62	Very Important
3. Communicate effectively in verbal and non-verbal communication	4.33	Very Important	4.44	Very Important	4.39	Very Important
4. Have a broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context	3.86	Important	4.20	Important	4.03	Important
5. Recognize the need for and engage in life-long learning	4.41	Very Important	4.44	Very Important	4.43	Very Important
6. Have a knowledge of contemporary issues or any event, idea, opinion or topic in computer engineering that is relevant to the present day	4.14	Important	4.48	Very Important	4.31	Very Important
ALL	4.28	Very Important	4.47	Very Important	4.38	Very Important
Legend: 4.21-5.00 Very Important 3.41-4.20 Important 2.61-3.40 Moderately Important 1.81-2.60 Slightly Important 1.00-1.80 Not Important						

The preceding table shows the means and equivalent verbal interpretation for each non-

technical skill rated by private and public sectors. The majority of non-technical skills were rated

Very Important by the private sector, mainly non-technical skills nos. 2, 1, 5, and 3 with a mean of 4.55, 4.41, and 4.33, respectively. However, non-technical skills nos. 4 and 6 were rated as only *Important* with a mean of 3.86 and 4.14, respectively. It was noted that non-technical skills nos. 4 and 6 are concerned with engineering issues. The possible reason why the private sector considered these two skills as only important is that these businesses or commercial establishments would not assume to be dealing with many engineering issues. Besides, an overall mean of 4.28 was obtained, with an interpretation of *Very Important*. This signifies that the private sector considers all non-technical skills as very important for BSCpE graduates to possess.

Also, in Table 5, it was observed that all non-technical skills were considered *Very Important* by the public sector, except for non-technical skill no. 4. Just like with the private sector, the public sector also feels non-technical skill no. 4 as only *Important*, with a mean of 4.20. Non-technical skill no. 4 focus on understanding the impact of engineering solutions in a global, economic, environmental, and social context. Despite rating it as only *Important*, BSCpE graduates are expected to design and develop hardware and software that aims to solve problems encountered in the community. Nevertheless, an overall rating of 4.47 was obtained, with an interpretation of *Very Important*. This implies that the public sector considers non-technical skills as very important for BSCpE graduates to have.

Furthermore, it was noted that a grand mean of 4.38 was obtained, with an interpretation of *Very Important*. This indicates that the non-technical skills presented to both the private and public sectors are considered very important for BSCpE graduates to possess, thus, needed to be included in the BSCpE curriculum.

What are other skills specified by industries in Zamboanga City that are important for BSCpE graduates to possess?

This section discusses other technical and non-technical skills that the private and public sectors specified and rated how they consider these as essential for BSCpE graduates to possess. Note that these technical and non-technical skills were not included in the survey questionnaire. Only

some of the respondents answered this part of the questionnaire.

Other Software Development Skills Recommended by Both Sectors

Four (4) private companies have stated that BSCpE graduates are expected to demonstrate the ability to know Structured Query Language (SQL), design a system using Systems Analysis and Design (SAD) concepts that incorporate or consider future upgrades, gather data correctly, and coordinate with clients. These skills are considered *Very Important* for BSCpE graduates to possess. The following are other *Important* software development skills that the BSCpE graduates should have. These include designing a system with an intuitive interface, developing reliable systems using different programming languages compliant with industry standards, and using secured, scalable, and cost-efficient solutions to maintain systems.

The public sector also listed software development skills that BSCpE graduates must possess. Six (6) respondents have said that it is *Very Important* for BSCpE graduates to demonstrate the ability to program using Object-Oriented Programming (OOP) languages such as VB.Net. BSCpE graduates should also apply structured and maintainable coding in developing systems and use an object-oriented design principle called SOLID in software engineering. The acronym SOLID stands for S—Single-responsibility principle, O—Open-closed principle, L—Liskov substitution principle, I—Interface segregation principle, and D—Dependency Inversion Principle. SOLID refers to the first five (5) Object-Oriented Design (OOD) principles introduced by Robert C. Martin (Oloruntoba, 2015).

Moreover, it is also *Very Important* for BSCpE graduates to demonstrate the following: manage software development projects in an agile way using the Scrum methodology and Test-Driven Development (TDD) techniques; do SQL and database administration; monitor, accomplish and deploy software development projects; do data encryption; perform device driver development; and give feedback and recommendations about computer systems. Furthermore, the public sector considers the following skills as *Important* for BSCpE graduates to possess. These include the

ability to design systems using SAD concepts and document software development projects.

Other System and Network Administration Skills Recommended by Both Sectors

According to nine (9) private companies, some of the *Very Important* system and network administration skills that BSCpE graduates should possess include the following: use command-line interface (CLI) in configuring CISCO devices such as routers and switches; assemble new system networks; configure, manage and maintain servers; manage cloud server infrastructure, and communicate with Internet service providers (ISP) and other communication companies. The private sector also recommended the following *Important* system and network administration skills. These include the ability to relate to different networking technologies, model network architecture, and perform data backups and disaster recovery options. Moreover, computer engineering graduates are also expected to operate master consoles to monitor computer systems and networks' performance, identify network problems, and install and configure devices such as closed-circuit television (CCTV), biometrics, and keycard systems.

The public sector also recommended that it is *Very Important* for BSCpE graduates to demonstrate the ability to troubleshoot IT equipment using A+ and practice knowledge on data center concepts, Building Industry Consulting Service International (BICSI) standards, and IT ethics and disciplines, including hacking. In addition, it is also best that BSCpE graduates have the ability to perform load balancing for computer networks, install, configure, troubleshoot and update operating systems and network devices, orient end-users on IT matters relevant to office operations, and perform system audits, quality control, data backup, and disaster recovery implementation. Furthermore, it was also suggested that BSCpE graduates should be proactive in managing computer networks. The public sector also emphasized that BSCpE graduates should understand satellites and software and network compatibility issues and appreciate analog and digital radio communication for land, air, and sea. Knowledge of Information Management Security

Systems (IMSS) was also considered *Moderately Important* for BSCpE graduates to have.

Other Technopreneurship Skills Recommended by Both Sectors

The private and public sectors suggested and rated the following technopreneurship skills as *Very Important* for BSCpE graduates to possess. BSCpE graduates should have the ability to pitch ideas effectively to investors and identify benchmarks for the business' continuous improvement. Some major courses in the BSCpE curriculum include Project Design, Technopreneurship, and Project Management. These courses allow computer engineering (CpE) students to research and implement something that is considered an innovation. The CpE students usually present their projects to panel members or even to people from the industries for possible investments. This activity is essential since it allows students to pitch their ideas—marketing their projects for investors.

Other Non-Technical Skills Recommended by Both Sectors

Six (6) private companies have said that it is *Very Important* for BSCpE graduates to have a keen awareness of system vulnerability and willingness to be assigned to other assignments. CpE graduates should also find alternative solutions to IT concerns that are effective, easier to implement, and less costly, manage their time effectively, and work overtime to meet deadlines. It is also *Important* for BSCpE graduates to have the ability to demonstrate humility by admitting their mistakes and accepting failures, and adapt ideas by converging different or existing technologies.

The public sector also recommended other non-technical skills for BSCpE graduates to possess. According to the results, BSCpE graduates need to demonstrate the ability to work under pressure to comply with task deadlines and deal with stress. It was also recommended that BSCpE graduates should be willing to multitask to comply with simultaneous or successive tasks, use a creative approach, and demonstrate resourcefulness in solving problems. Finally, computer engineering graduates should demonstrate knowledge of government policies and laws related to

information technology and basic customer-service.

Is there a significant difference in the needs of industries in Zamboanga City when data are grouped according to sector?

The following results present the difference in the level of importance of technical and non-technical skills when grouped according to the sector. An Independent Samples T-test was utilized to obtain the results for the last research question. These results determined if the needs of both sectors differ in terms of technical and non-technical skills.

Table 6: Difference in the Level of Importance of Software Development Skills According to Sector

Variable	Mean	t-value	p-value	Decision
Sector	Private 4.15	5.967	0.000	Significant
	Public 4.69			

Table 6 exhibits the difference in the level of importance of software development skills when categorized according to the sector. It was noted that a *t-value* ($t=5.967$) and *p-value* ($p=0.000$) were obtained, which is less than the assumed alpha of the 0.05 level of significance. Therefore, the hypothesis is rejected since there is a significant difference among the variables tested in this study. As observed in the table, when the mean of the private sector was compared with the mean of the public sector, it was found out that the mean of the private sector is less than the mean of the public sector. Thus, it is clear that there is a difference. This further indicates that both sectors differ on their needs in terms of software development skills.

Table 7: Difference in the Level of Importance of System and Network Administration Skills According to Sector

Variable	Mean	t-value	p-value	Decision
Sector	Private 4.29	3.986	0.002	Significant

Variable	Mean	t-value	p-value	Decision
Sector	Private 4.61	3.986	0.002	Significant
	Public 4.69			

The previous table shows the difference in the level of importance of system and network administration skills when categorized according to the sector. A *t-value* ($t=3.986$) and *p-value* ($p=0.002$) were obtained, which is less than the assumed alpha of 0.05 level of significance. Hence, the presumed hypothesis is rejected since there is a significant difference among the variables tested in this study. Looking at Table 7, when the mean of the private sector was compared with the mean of the public sector, it was observed that the mean of the private sector is less than the mean of the public sector. Therefore, it is evident that there is a difference. Moreover, the result implies that both sectors differ on their needs in terms of system and network administration skills.

Table 8: Difference in the Level of Importance of Technopreneurship Skills According to Sector

Variable	Mean	t-value	p-value	Decision
Sector	Private 3.92	0.625	0.546	Not Significant
	Public 3.99			

The preceding table displays the difference in the level of importance of technopreneurship skills when categorized according to the sector. A *t-value* ($t=0.625$) and *p-value* ($p=0.546$) were obtained, which is greater than the assumed alpha of 0.05 level of significance. Therefore, the hypothesis is accepted since there is no significant difference among the variables tested in this study. Based on Table 8, the means of both sectors are almost the same. Therefore, it is clear that there is no difference. The result further means that both sectors do not differ on their needs in terms of technopreneurship skills.

Table 9: Difference in the Level of Importance of Non-Technical Skills According to Sector

Variable	Mean	t-value	p-value	Decision
Private Sector	4.28	1.567	0.148	Not Significant
Public	4.47			

Table 9 shows the difference in the level of importance of non-technical skills when categorized according to the sector. A *t-value* ($t=1.567$) and *p-value* ($p=0.148$) were obtained, which is greater than the assumed alpha of 0.05 level of significance. Thus, the hypothesis is accepted since there is no significant difference between the variables tested in this study. As observed in Table 9, when the means of both sectors were compared, it was found out that the mean of the private sector is close to the mean of the public sector. Hence, it is clear that there is no difference in the needs of both sectors in terms of non-technical skills.

Conclusions

1. Among the technical skills, Software Development and System and Network Administration skills were described by industries in Zamboanga City as very important for BSCpE graduates to possess while Technopreneurship skills were described as important.
2. Non-technical skills were considered by Zamboanga City industries as very important for BSCpE graduates to have.
3. The private and public sectors listed other technical and non-technical skills that are important for BSCpE graduates. Both sectors emphasized software development and system and network administration skills.
4. There is a significant difference in private and public sectors' needs in terms of software development and system and network administration skills while no significant difference in terms of technopreneurship and non-technical skills.

Recommendations

1. It is recommended that both technical and non-technical skills be given emphasis in the redesign of the BSCpE curriculum to solve job mismatch.
2. The department of computer engineering may consider partnering with agencies that deal with software development and system and network administration to prepare better BSCpE graduates to work in the industry. Agencies such as Microsoft and CISCO give competency certifications to students and graduates that could be used as one of BSCpE graduates' credentials for future employment in the industry.

References

- [1] Association for Computing Machinery Committee for Computing Education in Community Colleges. (n.d.). *Computer Engineering*. Retrieved from <http://ccecc.acm.org/guidance/computer-engineering>
- [2] Bertram, D. (n.d.). *Likert's Scale*. Retrieved from <http://poincare.matf.bg.ac.rs/~kristina/topic-dane-likert.pdf>
- [3] Bianc J. (2014, March 25). *CHED: List of In-Demand College Courses for 2014-2018*.
- [4] Retrieved from <http://philnews.ph/2014/03/25/ched-list-of-in-demandcollege-courses-for-2014-2018/>
- [5] Biddix, J. P. (n.d.). *Research Rundowns*. Retrieved from <https://researchrundowns.com/quantitativemethods/instrument-validity-reliability/>
- [6] Career Profiles. (n.d.). *Computer Programmers*. Retrieved from <http://www.careerprofiles.info/computer-programmer-career.html>
- [7] City Government of Zamboanga. (n.d.). *Local Government Offices*. Retrieved from http://www.zamboangacity.gov.ph/index.php?option=com_content&view=article&id=16&Itemid=63

- [8] Computer Science Online. (n.d.). *What is Computer Engineering?*. Retrieved from <http://www.computerscienceonline.org/computer-engineering/>
- [9] Crossman, A. (2016). *Understanding Purposive Sampling*. Retrieved from <http://sociology.about.com/od/Types-of-Samples/a/Purposive-Sample.htm>
- [10] De Castro, E. L., Prenda, M. B., Dolot, J. A., Laguador, J. M., & Dotong, C. I. (2016). *Employers' Feedback on the Job Performance of Computer Engineering Graduates in an Asian Academic Institution*. Retrieved from https://www.researchgate.net/publication/309041063_Employers'_Feedback_on_the_Job_Performance_of_Computer_Engineering_Graduates_in_an_Asian_Academic_Institution
- [11] Dodge, Y. (n.d.). *The Concise Encyclopedia of Statistics*. pp
- [12] 565-566. Retrieved from http://link.springer.com/referenceworkentry/10.1007%2F978-0-387-32833-1_421
- [13] Dudovskiy, J. (2015). *Stratified Sampling*. Retrieved from <http://research-methodology.net/sampling-in-primary-data-collection/stratified-sampling/dun&bradstreet>. (n.d.). *Government Report Summary*. Retrieved from <http://www.hoovers.com/industry-facts/government.1693.html>
- [14] Enguerra, B. R. (2016). *Required Entry-Level Competencies of the Electrical Industry in Zamboanga City vis-à-vis Achieved Competencies of the Diploma of Technology in Electrical Technology Students of Zamboanga City State Polytechnic College*. Retrieved from the WMSU Library
- [15] Fandino, M. D. (2013). *Technopreneurship*. Retrieved from http://dancelfandinotechno.blogspot.com/2013/03/what-is-technopreneurship_19.html
- [16] Hagos, L. C. & Dejarne, E. G. (2008). *Enhancing Curriculum in Philippine Schools in Response to Global Community Challenges*. Retrieved from <http://ro.ecu.edu.au/cgi/viewcontent.cgi?article=1020&context=ceducomInc>. (n.d.). *Management Information Systems*. Retrieved from <http://www.inc.com/encyclopedia/management-information-systems-mis.html>
- [17] Investopedia. (n.d.). *T-test*. Retrieved from <http://www.investopedia.com/terms/t/t-test.asp> Iowa State University Electrical and Computer Engineering. (n.d.). *Careers in Electrical and Computer Engineering*. Retrieved from <https://www.ece.iastate.edu/employment/careers-in-electricaland-computer-engineering/>
- [18] Ivy Tech Community College. (n.d.). *Software Development*. Retrieved from <https://www.ivytech.edu/software-development/> Kasurinen, J., Mirzaeifar, & S., Nikula, U. (n.d.). *Computer*
- [19] *Science Students Making Games: A Study on Skill Gaps and Requirements*. Retrieved from http://www2.it.lut.fi/GRIP/publications/Koli_Kasurinenetal.pdf
- [20] Laguador, J. M. & Ramos Jr., L. R. (2014). *Industry-Partners' Preferences for Graduates: Input on Curriculum Development*. Retrieved from https://www.academia.edu/37343854/Industry-Partners-Preferences_for_Graduates_Input_On_Curriculum_Development
- [21] Lethbridge, T. C. (2000). *What Knowledge is Important to a Software Professional?* Retrieved from <http://www.idi.ntnu.no/~conradi/lethbridge-ieee-computer-may2000.pdf>
- [22] Licera, Jr. (n.d.) *Technopreneurship: What it is and what it is not*. Retrieved from <http://www.slideshare.net/rubenlicera/technopreneurship-what-it-is-and-what-its-not-20120506>

- [23] Mariñas, B. O. & Ditapat, M. P. (n.d.). *Philippines Curriculum Development*. Retrieved from <http://www.ibe.unesco.org/curriculum/Asia%20Networkpdf/ndrepph.pdf>
- [24] *Microelectronics*. (n.d.). Retrieved from
- [25] <http://www2.elo.utfsm.cl/~lsb/elo102/datos/microelectronics.pdf>
- [26] Neri, R. L. (2008). *Policies and Standards (PS) for the Degree of Bachelor of Science in Computer Engineering (BSCpE)*. Retrieved from <http://www.ched.gov.ph/wpcontent/uploads/2013/08/CMO-No.13-s2008.pdf>
- [27] *Network Administration*. (n.d.). Retrieved from https://www.its.bldrdoc.gov/fs-1037/dir-024/_3512.htm
- [28] Oloruntoba, S. (2015). *SOLID: The First 5 Principles of Object Oriented Design*. Retrieved from <https://scotch.io/bar-talk/s-o-l-i-d-the-first-five-principles-of-object-oriented-design>
- [29] Onwuka, E. N. (2009). *Reshaping Engineering Education Curriculum to Accommodate the Current Needs of Nigeria*. Retrieved from http://www.academicjournals.org/article/article1379612300_Onwuka.pdf
- [30] Pancho, J. (2012). *Bachelor of Science in Computer Engineering (BSCoE) Graduates of Western Mindanao State University: A Tracer Study*. Retrieved from WMSU Library Pearson. (n.d.). *Introduction to Software Development*.
- [31] Retrieved from <https://www.pearsonhighered.com/samplechapter/0130091154.pdf>
- [32] Penn State Behrend. (n.d.). *Computer Engineering*. Retrieved
- [33] from <http://psbehrend.psu.edu/about-the-college> Pfeffer, J. (2016). *What Does a Network Administrator Do? A Behind-the-Scenes Look*. Retrieved from <http://www.rasmussen.edu/degrees/technology/blog/what-does-a-network-administrator-do/>
- [34] Philippine Government. (n.d.). *Official Directory*. Retrieved from <http://www.gov.ph/directory/Quantitative>
- [35] *Research Methods*. (n.d.). Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwix8eLwcvRAhUFQLwKHfmKAT0QFggkMAA&url=http%3A%2F%2Fwww.tankonyvtar.hu%2Fhu%2Ftartalom%2Ftamop412A%2F2011-0021_22_research_methodology%2FCMRM6103_Research_methodology_08.pdf&usg=AFQjCNG64CNpWY4QFNEBWk6hkZyZ16Tkqw&bvm=bv.144224172,d.dGc
- [36] *Revised Policies, Standards and Guidelines for the Bachelor of Computer Engineering (BSCpE) Effective AY 2018-2019*. (2016). Retrieved from Commission on Higher Education (CHED)
- [37] Stat Trek. (n.d.). *Simple Random Sampling*. Retrieved from <http://stattrek.com/sampling/simple-random-sampling.aspx>
- [38] Techopedia. (n.d.). *Embedded System*. (n.d.). Retrieved from <https://www.techopedia.com/definition/3636/embedded-system>
- [39] Trochim, W. (2006, October 20). *The T-Test*. Retrieved from http://www.socialresearchmethods.net/kb/stat_t.php
- [40] University of Houston. (n.d.). *Computer Engineering Frequently Asked Questions*. Retrieved from <http://www.ee.uh.edu/undergraduate/computer-engineering-faq>
- [41] University at Buffalo School of Management. (n.d.). *Master of Science in Management Information Systems*. Retrieved from <https://mgt.buffalo.edu/degree-programs/master-of-science-ms/information-systems.html>

- [42] University of Michigan Electrical and Computer Engineering. (n.d.). *Computer Engineering*. Retrieved from https://www.eecs.umich.edu/eecs/undergraduate/ugce/computer_engineering.html
- [43] Virginia Tech Department of Electrical and Computer Engineering. (n.d.). *About Computer Engineering*. Retrieved from <https://www.ece.vt.edu/undergrad/aboutcpe>
- [44] Waweru & Omwenga (2015, June 6). *The Influence of Strategic Management Practices on Performance of Private Construction Firms in Kenya*. Retrieved from <http://www.ijsrp.org/research-paper-0615/ijsrp-p42108.pdf>
- [45] Western Mindanao State University. (n.d.). *College of Engineering and Technology*. Retrieved from <http://wmsu.edu.ph/college-of-engineering-andtechnology> Western Mindanao State University. (n.d.). *Enrollment Statistics*. Retrieved from http://wmsu.edu.ph/mywmsu/classlist/statistic_college.php?college=COLLEGE%20OF%20ENGINEERING20&%20TECHNOLOGY
- [46] *What are the Software Development Life Cycle (SDLC) Phases*. (n.d.). Retrieved from <http://istqbexamcertification.com/what-are-the-software-development-life-cycle-sdlc-phases/>
- [47] *What is Descriptive Research*. (2001). Retrieved from <http://www.aect.org/edtech/ed1/41/41-01.html>
- [48] WhatIs.com. (n.d.). *What is Private Sector*. Retrieved from <http://whatIs.techtarget.com/definition/private-sector>
- [49] *What is Technopreneurship?* (2013). Retrieved from <https://rhannieannmay.wordpress.com/2013/03/15/what-is-technopreneurship-2/>
- [50] Yaacoub, H. K., Husseini, F. & Choueiki, Z. (n.d.). *Engineering Soft Skills: A Comparative Study between the GCC Area Demands and the ABET Requirements*. Retrieved from http://www.academia.edu/12133801/Engineering_Soft_Skills_A_comparative_study_between_the_GCC_area_demands_and_the_ABET_requirements
- [51] Zaharim, A., Omar, Z., Basri, H., Muhamad, N., & Mohd Isa, F. L. (2009, November). *A Gap Study between Employers' Perception and Expectation of Engineering Graduates in Malaysia*. Retrieved from <http://www.wseas.us/e-library/transactions/education/2009/31-405.pdf>
- [52] *Zamboanga City*. (n.d.). Retrieved from <http://www.tourism.gov.ph/SitePages/InteractiveSitesPage.aspx?siteID=53>