Building 21st Century Job Skills In Electronics 1: Filipino and Indonesian Students' Perceptions on Their Preparation Today

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Highlights

- Collaborative research between the Philippines (represented by the FEU Institute of Technology) and Indonesia (represented by the Widya Mandala Catholic University Surabaya) on the perception of their students for their future jobs.
- Tackles the 21st century job skills expected of Engineering graduates.

Abstract

In a report by the World Economic Forum (2015), it was found out the top skills requirement in the 21st Century include (1) complex problem solving, (2) coordinating with others, and (3) people management, among others. In the context of Electrical and Electronics Engineering (EECE), a strategic time to start developing these Future Job Skills is during their first professional course (Electronics 1) and was hence, selected as dipstick. This pilot study sought to answer the following: (1) What were the perceptions of students enrolled in Electronics 1 in terms of honing Future Job Skills? (2) What were the factors that helped these students in improving their global employability while taking Electronics 1? (3) What action steps could be recommended in order to further improve the delivery of Electronics 1 in terms of honing global employability among students in the future? Following a descriptive research design and using both qualitative and quantitative research methods, a purposive sample of 76 students from the Philippines and 19 students from Indonesia enrolled in Electronics 1 (and its equivalent course in Indonesia) were surveyed. Results showed that top three future job skill honed in the class were (1) Critical Thinking (2) Active Listening and (3) Complex Problem Solving in the Philippines. In Indonesia, on the other hand, it is as follows: (1) Judgement and Decision Making (2) Cognitive Flexibility and (3) Coordinating with Others. It was also found out that the least honed was emotional intelligence in the case of the Philippines and negotiation in the case of Indonesia. This research suggests the modification of the Electronics 1 syllabus to add teaching and learning activities that would augment such weakness.

Key Words: Electronics Engineering; Future Job Skills; Student Perception Survey in the Philippines and Indonesia

1. Introduction

Student perception surveys are important tool in answering critical questions such as "Why do some classrooms or schools produce more learning than others, even with similar students? Or "What aspect of teaching practice make some teachers more effective at helping students learn?" (NYSED 2013) By finding out the answers to these important questions, the school can strategize on how to better improve the quality of education it provides its students.

Part of raising the quality of education is ensuring global employability. With the ASEAN Integration now in effect and the Fourth Industrial Revolution now at hand, the need for global employability is more

felt than ever. According to Schwab and Samans (2016), the Fourth Industrial Revolution has brought about advances in "genetics, artificial intelligence, robotics, nanotechnology, 3D printing and biotechnology" that translates to promising patterns of "consumption, production, and employment." However, this has also presented "major challenges requiring proactive adaptation by corporations, governments and individuals." Included in this adaptation is the acquisition of Future Job Skills that would make graduates more globally employable.

In a report by the World Economic Forum (2015), the top skills requirement for Engineering graduates include (1) complex problem solving, (2) coordinating with others, (3) people management, (4) critical thinking, (5) negotiation, (6) quality control, (7) service orientation, (8) judgment and decision-making, (9) active listening and (10) creativity. By the year 2020, the ranking has shifted and the top skills requirement would now be as follows: (1) complex problem solving, (2) critical thinking, (3) creativity, (4) people management, (5) coordinating with others, (6) emotional intelligence, (7) judgment and decision-making, (8) service orientation, (9) negotiation and (10) cognitive flexibility.

In the world of EECE, a good time to start developing these Future Job Skills is early on in their professional education. That is the reason while Electronics 1 (i.e., Electronics Devices and Theory), the very first professional course of EECE, has been selected as the dip stick in terms honing Future Job Skills. A good place to start this investigation is Indonesia as both nations are now adapting to the impact of the ASEAN integration. Both nations are also proximate to one another and hence, a study such as this would be a good benchmark in order to provide insights as how to mutually improve Electronics 1 in the respective nations.

2. Methods

2.1 Research Questions

This pilot study, therefore, sought to answer the following research questions: (1) What were the perceptions of students enrolled in Electronics 1 in terms of honing Future Job Skills? (2) What were the factors that helped these students in improving their global employability while taking Electronics 1? (3) What action steps could be recommended in order to further improve the delivery of Electronics 1 in terms of honing global employability among students in the future?

2.2 Design and Sampling

This study employed both qualitative and quantitative research methods and implemented a descriptive research design. Purposive sampling of 76 students from the Philippines and 19 students from Indonesia enrolled in Electronics 1 were administered a survey that measures their perception on how much the course, their teacher, and the individual students have helped them improve their global employability. In the Philippines, the respondents were 85% male and 15% female while in Indonesia, it is 80% male and 20% female. The age of students range from 18-20 years old. The year level of the students varies from second to third year due to variations in time they were able to pass the pre-requisites of Electronics 1. The survey was administered in the opening of classes (early September 2019). The respondents were also asked to explain their rating so that researchers would know where they were coming from. Then, respondents were also asked to rank the present and Future Job Skills that were honed during the duration of the course and to explain their choice for the first and for the last one in rank.

3. Results and discussion

In the Philippines, Electronics 1 has the descriptive title, "Electronic Devices and Circuits" or basically "Analog Electronics" in Indonesia. It is the first professional course offered to Electronics and Electrical Engineering students in the Philippines and Indonesia respectively.
In Indonesia, the course learning outcomes include describing and analyzing basic electronic components such as diode and transistor. Students are also expected to be able to explain and identify the basic characteristics of these devices, calculate the use of these components in the circuit and know the use of these components in the circuit. In the Philippines, there are only two basic differences: (1) the discussion of operational amplifiers which Indonesia included in its Electronics 1 is deferred to Electronics 2, and (2) the emphasis on power supply as an application of Electronics 1 is only done in the Philippines.

In terms of the learning models, both the Philippines and Indonesia use lecture, group discussions, exercises and examinations as part of the teaching and learning activities. The difference in these two nations is Indonesia's emphasis on developing oral skills as exemplified by the Oral Examination requirement. In the Philippines, on the other hand, there is an emphasis on developing practical skills as exemplified by the addition of a laboratory activities that go together with the discussions.

One thing that is lacking countries is that students are not made aware that Future Job Skills can and are developed in Electronics 1. An example of this would be critical thinking. If a student is asked to solve diode circuits, this would be inevitably developed. However, it is not explicitly included in the course learning outcomes that the students should "develop critical thinking" nor there is any remark in the syllabi that the course tries to develop the Future Job Skills. Before this survey, there is no measure or even just a description on the level of attainment of these skills. Thus, this would be an area of opportunity for the two nations and recommendations regarding this can be read toward the end of the discussion.

As for the assessment of the said course, results showed that for the top future job skill honed in the class in the Philippines were as follows: (1) Critical Thinking; (2) Active Listening; (3) Complex Problem Solving; (4.5) Creativity; (4.5) Coordinating with Others; and (6) Judgment and Decision Making. The other skills did not make it in the list because they have zero frequency. (See Table 1.)

Table 1-A. Top Future Skills Honed in Electronics 1.

Skill	Philippines		Indonesia	
	Rank	Frequency	Rank	Frequency
Critical Thinking	1	27	---	---
Active Listening	2	19	4.5	2
Complex Problem Solving	3	13	7	1
Creativity	4.5	7	4.5	2
Coordinating with Others	4.5	7	3	3
Judgement and Decision Making	6	3	1	5
Cognitive Flexibility	---	---	2	4
Negotiation	---	---	7	1
Emotional Inteligence	---	---	7	1

In contrast, the first three ranks in Indonesia are (1) Judgement and Decision Making, (2) Cognitive Flexibility and (3) Coordinating with Others. These are followed by (4.5) Active Listening, (4.5) Creativity, (7) Complex Problem Solving, (7) Negotiation and (7) Emotional Intelligence.

For the future job skill that was least honed in class, the ranking and frequency were as shown below.

Table 2. Top Future Skills Least Honed in Electronics 1.

Skill	Philippines		Indonesia	
	Rank	Frequency	Rank	Frequency
Emotional Intelligence	1	30	---	---
Negotiation	2	21	1	6
Service-Orientation	3.5	6	3.5	3
Creativity	3.5	6	---	---
Judgement and Decision Making	5	7	5.5	1
Complex Problem Solving	6.5	3	3.5	3
People Management	6.5	3	5.5	1
Active Listening	9	1	---	---
Coordinating With Others	9	1	2	5
Cognitive Flexibility	9	1	---	---

As seen in Table 2, ranking in the Philippines is as follows: (1) Emotional Intelligence; (2) Negotiation; (3.5) Service Orientation; (3.5) Creativity; (5) Judgement and Decision-making; (6.5) Complex Problem-Solving; (6.5) People Management; (9) Active Listening; (9) Coordinating with Others; and (9) Cognitive Flexibility. In Indonesia, it is (1) Negotiation, (2) Coordinating with Others, (3.5) Service-Orientation, (3.5) Complex Problem Solving, (5.5) Judgement and Decision Making, and (5.5) People Management

As for the role of the course, the teacher, and the self, respondents agreed that all these are perceived to help them improve their global employability. (See Table 4.) This is based on the Likert Scale given on Table 3 below.

Table 3. Likert Scale.

Interpretation	Lower Limit	Upper Limit
Strongly Agree	4.50	5.0
Agree	3.50	4.49
Neutral	2.50	3.49
Disagree	1.50	2.49
Strongly Disagree	1.00	1.49

Table 4. Role of the Course, Teacher and the Self.

Statement	Average Rating in the Philippines	Average Rating in Indonesia	Interpretation
This course has helped me improve my global employability.	4	4	Agree
The teacher of this course has helped me improve my global employability.	4	4	Agree

The manner I have studied this course has helped me improved my global employability	4	4	Agree

In terms of descriptive remarks, below were noted from the students:

3.1 On The Course

Despite formal orientation and mention of how the course would help students improve global employability by developing Future Job Skills, students are apparently aware of it as can be seen from their remarks:

> "This course and its syllabi are designed to be globally competitive in the Industry".
>
> "[The course] teaches us to be realistic and practical. It helped us as guidance in each situation in our [lives]. It help[s] us to think first before make any decision."
>
> "As we all know that we are already in the [21st] century, and I believe that this engineering field will help me in my global employability because Electronics Engineering is one of the in demand jobs nowadays. Additionally, engineering is a tough course and it is very challenging."
>
> "The field of both software and hardware engineering is widely applicable in this time of innovation."
>
> "Through this course, it helped me understand the difficulties of the outside world."
>
> "Electronics and Devices is the foundation of the field we are taking so it serves as a big factor for my global employability."
>
> "[This] course [has] helped me improve my social skills and flexibility as a person because of group works."
>
> "[In this] course, I am going to apply all the lessons that I learned in this course during my job.
>
> "The course prepared me to become more knowledgeable about the program to compete for the future's industry."
>
> "The course aided in the development of teamworking skills as well as creative and systematical thinking regarding electrical circuits which enables students in understanding and designing working electrical equipments as well as making decisive and effective decisions in solving complex problems."

To a certain extent, the teaching and learning activities are viewed to be much connected to the development of Future Job Skills. This, however, can be further improved by adding formal discussion about in during the course orientation of Electronics 1 to increase awareness among the students.

3.2 On The Teacher

The teacher appears to be instrumental in helping the students acquire these Future Job Skills. Some of the notable remarks coming from the students is as follows:

> "The professor taught me how to learn things by myself."
>
> "The teacher did a good job of teaching the course. He used a lot of technique[s] to make us learn fast."
>
> "[The teacher] teaches us all the principles that we need to know and also tells us some of his experiences in the industry."

"The professor has showed great communication between student and teacher which will help me with interacting with other people."

"Definitely, because he is an engineer, a professional electronics & communications engineer, that's why he motivates me [a] lot just by his degree."

"[The teacher] helped me in the way that he always connect it to real life situations perfectly."

"As an expert in the field, the teacher managed to give good lectures as well as aided in understanding various hard-to-understand materials which is in part due too his extensive experience and out-of the-box way of thinking that encourages the students to develop an engineer mindset to solve problems. The teacher's way of teaching also created many opportunities for project discussions and helped in preparing and presenting projects."

In an age where educational system are gearing towards student-centered learning, many people can think that the teacher now carries a less important role as they move away from the "center stage" in favor of the students. The remarks above given by the students clearly shows that such worldview is false. Even in student-centered environments, the teacher still plays a crucial role in honing the skills of the students. In the case of this study, it's not only academics that was honed but even the Future Job Skills.

3.3 On The Self

Remarks from the students reveal that they are also able to recognize their role in developing Future Job Skills:

"I agree because we have a lot of work in this course."

"If I study for this course, my skills will improve and it [will raise] me up.

"I know I do my best and helping myself do better at this course."

"I give my best to this course and it motivates me because of wat is ahead after finishing this course."

"I learned to depend on books for notes and it helped me a lot."

"I failed during the midterm period and that gives me motivation to persevere more."

"The manner of study that I do still needs improvement to reach the requirement for global employment."

"Good time management, eagerness to learn, strongwill, persistency, and the ability to take initiative aided in the students' ability to pass the course as well as their overall employability."

Such recognition is important because that means students are able to take responsibility for their employability in the future.

Based on the computed average rating of 4.0 for the two countries and validated by these remarks, it was determined that the course, the teacher, and the individual are all perceived to be contributing factors in both the Philippines and Indonesia.

In order to further improve the delivery of Electronics 1 in terms of honing global employability, the following are recommended:

(1) Increase awareness of Future Job Skills being developed. More than just going through the activities, it is important that students are formally made aware of the 21st Century Job Skills and how these are integrated to the course. This can be done by allotting some time for this in the

course orientation and also relating the activities to it throughout the term. It would also be good to measure the level of attainment of these skill towards the end of the course.

(2) Include group activities. A student short-film such as the one previously described would be a good teaching and learning activity. Not only would this break the cycle of lecture and computation but this would also force the students to interact with one another and in the process, develop their emotional intelligence, negotiation, service-orientation, and creativity skills as well.

(3) Strengthen weak areas. For instance, processing of group activities may include a time of processing of the emotional responses the members of the group had during the duration of the activity to address emotional intelligence.

(4) Gamify the subject. Include a game time where students compete for limited resources and would have to negotiate in order for them to be able to trade more extensively. This will train them in negotiation while building emotional intelligence.

(5) Use e-learning more extensively. Student learning outside of the classroom must not be undermined. Activities geared towards developing skills that are not directly related to the course (e.g. coordinating with others) may be served online.

(6) Research more comprehensively. As this research is a pilot study, the insights it can offer are much more limited compared to a full-blown longitudinal study. Further research should reveal not only the perceived honing of Future Job Skills but also the correlation of such future job skill with the trainings at the present.

4. Conclusions

Electronics 1 is generally perceived as a course that hone a number of Future Job Skills, although these skills would vary from nation to another. (See Table 1.) Based on the study, the job skill that was perceived to be most honed in Electronics 1 in the Philippines is critical thinking. This is defined by World Economic Forum (2015) as "using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, or approaches to the problem." In Indonesia, on the other hand, the perceived most honed skill is Judgement and Decision Making which is defined as "Considering the relative costs and benefits of potential actions to choose the most appropriate one" by the World Economic Forum. It can be noted that these two skills are very much related to one another.

This can be attributed to the fact that the nature of the course demands this. Electronic Devices and Circuits students need to imagine the movement of holes and electrons in various devices. They also have to solve various problems, each with different approaches and solutions. The student has then to determine the best of these approaches, especially during quizzes, exams and laboratory experiments.

The least honed skill, however, is emotional intelligence in the Philippines. This is defined by World Economic Forum (2015) as "Being aware of others' reactions and understanding why they react as they do." This can be addressed by adjusting the teaching-learning strategy in Module 1 – History of Semiconductors. (See Figure 1.) Instead of the usual discussion, a class of 40 students, for instance, may be divided into three groups. Each group which is made up of cast and crew shall create a 10-minute short-film on the history of electronics which will be uploaded in YouTube (and other social media) and

which will also be shown in class. Then their experiences and learnings can be processed in class. In the processing, the teacher may give special attention to emotional intelligence, negotiation, service-orientation, and creativity. (i.e., the top four least honed skills. See Table 2.) That way, this weakness may be addressed in the course.

In Indonesia, the least honed skill is Negotiation. This is defined by World Economic Forum (2015) as "bringing others together and trying to reconcile differences." Perhaps this is due to the fact that Indonesian negotiations are much different from Western. Moreover, it is culturally ingrained and may therefore be seen as less relevant than other Engineering skills such as mathematical design, for instance. (See Indoconsult (2017) for discussion on how different Indonesian consultations are from the ones Westernerns are accustomed to.)

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