Turkish Journal of Computer and Mathematics Education Vol.12 No.9 (2021),1104-1115

Research Article

Comparative Studies: Teaching Activities In Technical Universities Between Engineering And Non-Engineering Educators In Malaysia

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Article History: Received: 10 January 2021; Revised: 12 February 2021; Accepted: 27 March 2021; Published online: 20 April 2021

Abstract Education in general and teachers in particular play a very important role in meeting the demands of the 21st century and, with the rapid advancement of technology, teachers face greater challenges in choosing teaching methods for optimal learning, which include considerations of the learning environment, the context of students and the content of learning. Educators who involved in Technical and Vocational Education and Training (TVET) must properly prepare their students to live and work in the 21st Century. This preparation includes providing themselves to apply the solid knowledge and skills by developing instruction based on contemporary educational thinking and practices. The aim of this study was to generate empirical evidence on the differences in the teaching activities used by educators in technical universities for developing 4C skills. A hundred of each engineering and non-engineering educators from Malaysia were surveyed on the teaching activities that they used to promote 4C skills among their students. The results have shown that there were similarities and differences of the method used by the teachers The 4Cs learning activity instrument was used to gather data on activities sued by teachers for developing critical thinking, communication, collaboration and creativity. The findings have shown that the methods used by the educators varied depending on backgrounds of the educators. In general, engineering educators tend to be different in their teaching activities between non engineering educators. The findings have created a better understanding on how educators may differentiate their activities according to background which could be useful knowledge for future inter-programmed and inter-country collaborations

Keywords 4Cs Teaching Activities, 21st Century Skills, Engineering & Non-Engineering Educators, Technical University Educators

1. Introduction

The emergence of 4C abilities (critical thinking, collaboration, communication and creativity), which are part of the learning skills of the 21st century, has contributed to a profound shift in many educational systems around the world. Accordingly, many curricular development plans and programs have been designed and conducted for the purpose of integrating these skills [1]. The 21st century learning which is an education reform that aims to equip every student with the essential skills to face 21st century challenges [2] was first introduced to Malaysia in 2014. Incorporating these skills into the curriculum requires a shift in practices pertaining to the learning resources, teaching techniques and assessment approaches used for teaching and learning as education for the 21st century demand different emphasis from the previous century [3]. Education in the 21st century is expected to equip students with the capacity to think creatively and critically in problem-solving [4] i.e., students who are ready to enter the post-industrial era (industrial revolution 4.0). The importance of teaching 4Cs has been highlighted by The National Education Association (2015) in its reports which states that 80 percent of executives agree that emphasizing 4Cs in education would make students better equipped to join the workforce.

To meet the demand of the 21st century, education in general and teachers in particular play a very important role and with the rapid development of technology, teachers are facing greater challenges in selecting the teaching methods for optimum learning which requires considerations of the learning environment, students' background and learning content. Diverse teaching methods have been proposed on how to integrate the teaching of all four C's components [5-8]. However, the teaching methods proposed did not consider the potential contribution of students' backgrounds or content (i.e. engineering and non-engineering students) in the decision making process. Thus, this study aimed to determine how educators integrated their teaching activities into the curricula to develop 4Cs skills among students of engineering and non-engineering background. Comparison will also be made between Malaysian and Indonesian educators' practices to seek an understanding on similarities and differences which will be potentially useful in future collaborations. The rest of this paper is organized as follows; literature review, research method, data analysis results, discussion and conclusion.

4Cs Learning Skills

Teaching is an art and thus, different teachers teach differently depending on preferences, content and students who may have different learning methods that they prefer. Teachers will select the best instructional approach for students; work with students more effectively as they gain experience to become a superior teacher in general. Thus experienced teachers are implementing diverse teaching methods in considerations of students' learning styles to ensure students are successful.

Various teaching methods and learning activities have been proposed in the literature aimed at integrating the 4C's skills components. One of the teaching techniques that have been established as an effective teaching method is collaborative learning involving students in small groups of varying ability levels [7]. This style of teaching adopts a variety of learning activities to promote comprehension of the subject matter. Each participant of a group also has the responsibility to help another group member learn. Group member often has a particular role and everyone needs to be involved in the learning as the group's progress typically depends on each individual member's good work. For example, [7] has identified the effect on 4C's skills learning between collaborative inquiry learning model and conventional learning among the school students in Medan. The finding indicates that collaborative inquiry learning model is better than the conventional learning in improving students' 4Cs' skills in physics focusing on topics namely, material impulse, momentum and collisions in high school.

Using appropriate teaching activities communication skills development which is one of the components of 4Cs skill is also crucial. Furthermore, advances in digital technology, evolving career environments and competitive colleges and workplaces environments make communication skills essential for both engineering and non-engineering students [9, 10]. For example, [11] have explained 4C skills in a partnership with education and create links with language teaching and incorporation into the 4 language skills (reading, writing, listening, speaking. In addition to communication, another aspect of developing 4Cs skills that needs to be considered is the creativity aspect as creative thinking (a complement to critical thought) is an invaluable ability for college students. Teachers also need to be creative as it lets teachers look from a fresh viewpoint at issues and situations [12]. Creative thinking is a way of creating new approaches that are not entirely based on past or existing approaches. Ritter [13] have stated the important implications for educational and organizational settings, since they suggest that this brief creativity training (or one using similar cognitive techniques) could be implemented to facilitate creative thinking skills. [14] have studied the relationship between creative thinking and critical thinking skills of students by using the California Critical Thinking Disposition Inventory and the Torrance Test of Creative Thinking. The study has found that positive significant relationship between creative and critical thinking among graduates in the Departments of Visual Arts or Religion & Ethics Education stems from the propensity of these students to use non-routine problem-solving methods arising from the complexity of their learning environment and educational outcomes.

Another skill that is emphasized in the 21st century is critical thinking skill [15]. Critical thinking is the ability to undertake self-directed, self-disciplined, self-monitored learning process which is important in discovering new knowledge and improving the performance in the workplace. For example, an innovative approach to issue doesn't just require getting new ideas; the new ideas that are being produced must also be useful and important for the job. Thus, critical thinking plays a crucial role in evaluating new ideas, selecting the best and, if necessary, modifying them. [16] have studied a model of learning that could be used to help teachers master 4Cs. The initial concept developed was Project-Based Learning (PjBL) teacher training model while. [17] have discussed the importance of Socrates and chemical representation questions to stimulate the creative-critical thinking skills of chemistry pre-service teachers. Besides, [18] stated that lecturers should consider inquiry approaches as an alternative learning, particularly for new university students to motivate critical thinking skills and creative thinking skills as there is significant correlation between these two elements that can contribute significantly to cognitive learning outcomes.

Based on the studies above, it shows the importance of the 4C's skill for future workplace demand and needs. In conclusion, critical thinking skills improve the commitment and performance of the educators. Students with good critical-thinking and problem-solving skills are more likely to be inspired for academic success, and less likely to be negatively impacted. Besides, in the context of creative learning, creativity provides a robust platform. Students who express themselves creatively exhibit less dissatisfaction, establish a learning pleasure, and gain respect for other perspectives [18]. Developing communication skills through enjoyable and constructive approaches fosters a sense of self-esteem, promotes healthy emotional growth and facilitates teamwork. The 4C's skills help in to develop executive skills. For example, skills include preparation, scheduling and strategizing. These abilities help students develop self-regulation, working memory, and cognitive flexibility to enable them to learn new ideas and improve their social-emotional skills.

2. Materials and Methods

The survey research design with quantitative approach was applied in this research. A set of questionnaire was designed based on the collected teaching method and activities found in literature based on 4C's domain. A total of 200 respondents were randomly selected from all faculties in Universiti Tun Hussein Onn Malaysia, UTHM (i.e. Faculty of Civil Engineering and Built Environment, Faculty of Technology Management and Business, Faculty of Technical and Vocational Education, Faculty of Electrical and Electronic Engineering, Faculty of Computer Science and Information Technology, Faculty of Applied Sciences and Technology and Faculty of Engineering Technology). The selection of educators was based on their core teaching subject, research interest and degree. For non-engineering educators, respondents were mainly language and management teachers and engineering educators which is selected from engineering departments in engineering faculty. The survey questionnaire was consisting of four main sections that represent the 4C's component, and the demography profile. This questionnaire was deployed online from the university's online forum and platform. Respondents were able to complete the questionnaire approximately 10-15 minutes. There is no issue arise during the survey.

3. Finding and Discussion

The findings discussed are based on the data of the 21st century and 4C's learning skill activities items that were constructed. Data that had been collected were analyzed in the context of 4C's learning skill activities and descriptive statistical analysis including frequency and percentage were used to analyzed and interpret the finding in this research. An explanation of the frequencies and percentage was based on the interpretation in the research instrument. Level of agreement was used to measure the perception form Yes or No that had been chose by the educators in both fields.

3.1 Comparison of The Teaching Activities Between Engineering and Non Engineering Educators

Comparing with the engineering education in relevant international universities, we still need to make great efforts to improve and develop (Zhu, 2015). This distinction needs to be made because educators in this study involve different backgrounds such as engineering and non-engineering, where each of them has different abilities and skills that include Critical Thinking, Communication Collaboration and Creativity. The teaching style of an instructor (authoritative, hierarchical, and permissive) influences the experience of the students. It can give rise to functional or non-functional expectations of learning, and self-efficacy and thus an effective teaching style can help avoid demotivated students. Teachers play an important role to ensure learning involve positive attitudes, the desire to gain information, allowing learners to expand their own information and then apply their knowledge to everyday life. Therefore, this section is presented the comparison of the preferred teaching methods of non-engineering and engineering educators, by assuming both of the field have different learning activities to each other.

3.1.1 Comparison of Teaching Activities between Engineering and Non Engineering Educators (Critical Thinking).

The comparison of teaching practices based on critical thinking within engineering and non-engineering educators was presented in Figure (1) Critical thinking is one of the key skills of the 21st century and is widely discussed in literature from different perspectives, especially the teaching process. Caratozzolo [19] emphasized the role of instructors in developing an inquiry-based environment and the required tools to improve critical thinking for engineering students' career. For engineering point of views, ten's activities were identified such as active reading, heterogeneous grouping, problem solving and research subject as shown in figure below. Besides, ten teaching activities also were obtained for non-engineering's educator as shown. Both teaching activities are similar to each other, however, some of activities in non-engineering is not related to the engineering's educator such as brainstorming, experiments, concept map, essay and response journal were found.

Based on figure (1), findings show that Active Reading (98%) activity recorded the highest percentage among Engineering educators, while for Non-engineering educators showed Problem Solving (92%) activity recorded the highest percentage value compared to its other activities. The findings also indicate that for

engineering educators, Compare and Contrast (77%) activities have the lowest percentage, while Concepts Maps (62%) activities indicate the lowest results for non-engineering educators.

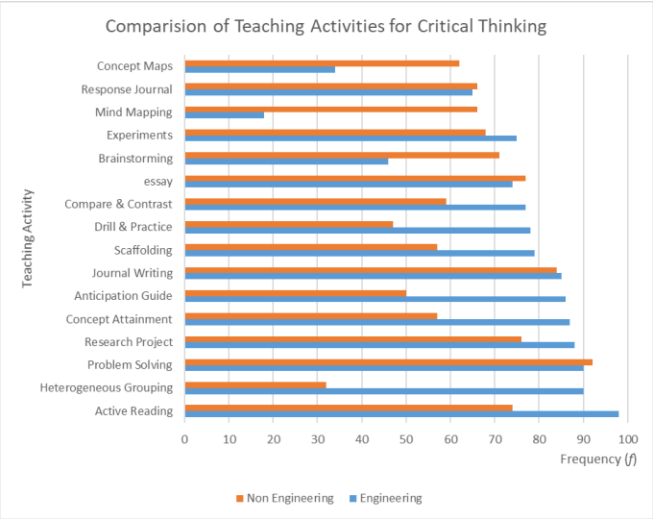

Figure 1: Comparison of Teaching activities for critical thinking between engineering and non-engineering educators (Critical Thinking)

Table 1 shows the frequency and percentage of the both engineering and non-engineering educators. The active reading (f = 98), heterogeneous grouping (f = 90), problem solving (f = 90) and research subject (f = 90) shows the most teaching method used within engineering educators. Furthermore, the least teaching method used is compare and contrast. However, it is still matter because comparison and contrast is important to find differences and/or similarities in certain basics or concept of subjects. This method can help educator to organize new ideas and knowledge thoroughly. Differences and similarities between objects, ideas, individuals, concepts, events, or other subjects can also be noted by students.

On the basis of the findings, it can be understood that in the teaching and learning process, engineering and non-engineering educators have different abilities that they can think objectively based on current circumstances. As the study was conducted by Facione [20] critical thinking is centered on updating existing knowledge by analyzing new situations based on the field that related through performing comparisons, establishing relationships, extracting new ideas and evaluating truth, utility and consequences of findings. Thus, these findings may suggest that the learning activities used by engineering and non-engineering are dramatically different.

Table 1: Comparison of Teaching activities for critical thinking between engineering and non-engineering educators

Engineering				**Non Engineering**			
Teaching Activity	f	%	Rank	**Teaching Activity**	f	%	Rank
Active Reading	98	98	↓	Problem solving	92	92	↓
Heterogeneous Grouping	90	90		Journal Writing	84	84	
Problem Solving	90	90		Essay	77	77	

Engineering				Non Engineering			
Teaching Activity	f	%	Rank	**Teaching Activity**	f	%	Rank
Research Project	88	88		Research Project	76	76	
Concept Attainment	87	87		Active Reading	74	74	
Anticipation Guide	86	86		Brainstorming	71	71	
Journal Writing	85	85		Experiments	68	68	
Scaffolding	79	79		Mind Mapping	66	66	
Drill & Practice	78	78		Response Journal	66	66	
Compare & Contrast	77	77		Concept Maps	62	62	

3.1.2 Comparison of Teaching Activities between Engineering and Non Engineering Educators (Communication)

Effective communication one of the most essential life skills to learn. Communication is described as transmitting information for understanding. This can be achieved vocally (by verbal exchanges), by written media (books, blogs, and magazines), visually (using graphs, charts, and maps) or nonverbally (body language, movements, voice pitch, and tone). These communication skills are vital soft skills for a good career for educators. A strong and different communication skills including the ability to express thoughts clearly and persuasively both orally and in writing, articulate opinions, communicate instructions are coherent and motivating others through speech.

Communication in 21st century is characterized by the nature of the communication itself which tends to be more and more globalized. Communication skills include sharing ideas through oral, written, or non-verbal media. The comparison of teaching activities in engineering and non-engineering educators focusing on the communication aspect in 21st century skills was presented in Figure 2.

The teaching approaches that were used on both engineering and non-engineering educators had differences measured in all. Nonetheless, some of the elements have completely different activities which were used by both fields in their teaching practices. For example, cooperative learning, brainstorming, assigned question, concept formation and jigsaw activities are favored by engineering educators but not by non-engineering educators. While there are other examples, non-engineering educators had chosen the homogeneous grouping, reflective discussion and heterogeneous grouping but not for the engineering educators.

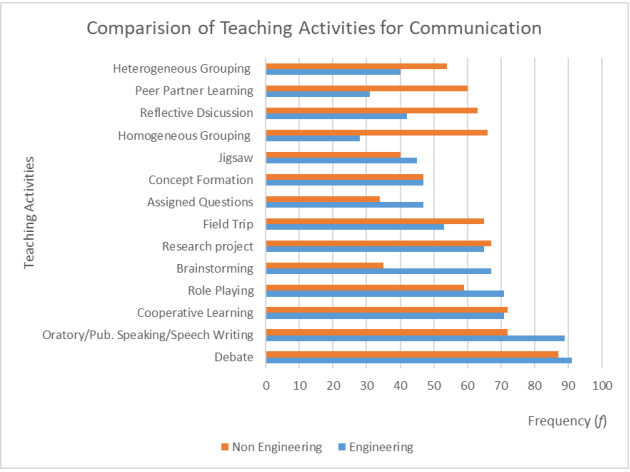

Figure 2: Comparison of Teaching activities for critical thinking between engineering and non-engineering educators (Communication)

Referring to the Table 2, it is shown that engineering educator and non-engineering educators have higher scores in the same activities as debate which score is for engineering educators (f = 91, 91%) and non-engineering educators (f = 87, 87%). The finding is matter as nowadays debate is an interesting discussion among teachers. Debate exercises are important so skills and experience can be developed. It helps students to become optimistic and helps students to build skills in communication [21]. It is supported by Fauzan [22], who said that in discussions, students gradually share their thoughts and opinions. This debating exercise stimulated the imagination of students to explore language, as they were asked to build their arguments from other motions. Students acquainted with the motions and they found it convenient to comment on topics. By engaging in debating practice, students are able to improve their fluency and confidence.

Besides, cooperative learning and public speaking were listed as the higher agreement among the educators from both field. Students taught using lecture-based instruction had lower scores on resource utilization and cognitive-metacognitive approaches post-tests relative to students taught using cooperative learners [23]. Since field trips are one of the teaching activities that can promote communication, educators often highlight the need for these activities in their teaching and learning processes (f = 65, 65 percent and f = 63.63 percent).The finding is supported by Makanjuola [24] that studied the effect of field trip and cooperative learning strategies on junior secondary school student's concept attainment in social studies and suggested that teachers in social studies should use the two pedagogical methods of field trips and cooperative learning to promote good citizens and properly internalize social studies principles in education systems. Besides, various of the cooperative learning activities can be implemented such as think-pair sharing, students lead teaching and three minutes' reviews. It shows that there are no similarities in value between both fields. Nevertheless, these results can conclude that the learning activities that engineering and non-engineering uses are significantly different.

Table 2: Comparison of Teaching activities for communication between engineering and non-engineering educators

Engineering				**Non Engineering**			
Teaching Activity	f	%	Rank	**Teaching Activity**	f	%	Rank
Debate	90	91		Debate	87	87	
Oratory/PublicSpeaking/Speech Writing	89	89		Cooperative Learning	72	72	
Cooperative Learning	71	71		Oratory/PublicSpeaking/Speech Writing	72	72	
Role Playing	71	71		Research Project	67	67	
Brainstorming	67	67		Homogeneous Grouping	66	66	
Research Project	65	65		Field Trip	65	65	
Field Trip	53	53		Reflective Discussion	63	63	
Assigned Questions	47	47		Peer Partner Learning	60	60	
Concept Formation	47	47		Role Playing	59	59	
Jigsaw	45	45		Heterogeneous Grouping	54	54	

3.1.3 Comparison of Teaching Activities between Engineering and Non Engineering Educators (Collaboration)

Figure 3 illustrates the gaps between engineering and non-engineering educators in collaborative teaching activities at technical universities. Collaboration is referring to the educators and student who work together that aimed to achieve a shared goal, when every student play role in completing tasks during teaching and learning process. Referring to the figure below, compared to other tasks, peer partner learning demonstrates the highest outcomes for engineering educators. Meanwhile, in contrast to other practices, Cooperative Learning produces the greatest effects for non-engineering educators. In addition, the findings also show that the lowest findings for engineering educators are shown by interdisciplinary approach practices, while experimental practices show the lowest results for non-engineering educators.

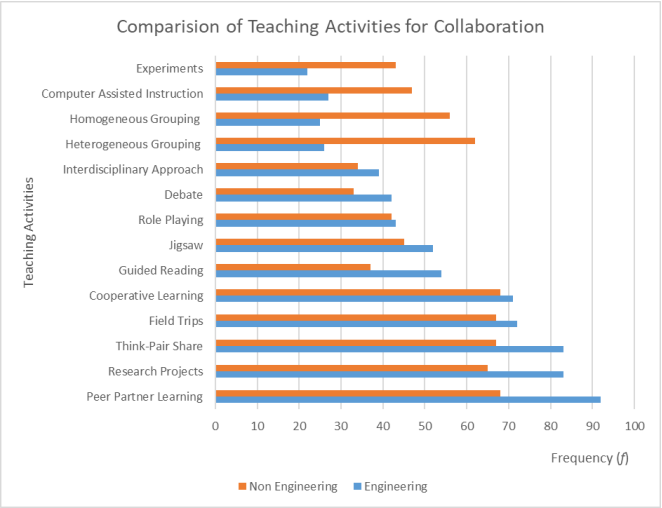

Figure 3: Comparison of Teaching activities for critical thinking between engineering and non-engineering educators (Collaboration)

Referring to table 3 below, peer partner learning (f = 92,92%), research project (f = 83, 83%) and think –peer share (f = 83, 83%) have obtained the most three higher agreements within engineering educators. The finding also represented that educators were aware with the importance of the collaboration element and implement it during teaching and learning process. For example, peer partner learning was obtained higher agreement from both engineering (f = 92, 92%), and non-engineering educators (f = 68, 68%), on the collaboration skills, this is matter due to students are able to gain more feedback as they are working with other students to reinforce points. The specific development in cognitive, psychomotor and affective domain can be achieved simultaneously.

Besides, for the non –engineering educators, the most three teaching method were obtained such as cooperative learning (f = 68, 68%), peer partnership learning (f = 68, 0.68%), field trips (f = 67, 67%) and think –pair share (f = 67, 67%). The teaching approaches that were used on both engineering and non-engineering educators had differences measured in all. Nonetheless, some of the elements have completely different activities which were used by both fields in their teaching practices. Cooperative learning activities, for example, are preferred by engineering educators but not by non-engineering educators. While there are other examples, non-engineering educators choose the Heterogeneous activity, but not the engineering educators. It shows that there are no similarities in value between both fields. Nevertheless, these results may conclude that the collaboration activities for both fields are significantly different.

This results were in line with Roekel [25] the stated that the different skills of effective communication and collaboration can help avoid misunderstandings and miscommunication during teaching and learning process. The activities in collaboration is an attempt to demonstrate the ability to work effectively and respectfully with diverse teams to achieve common goals with shared responsibility. Snyder [26] stated that the different skills of effective communication and collaboration can help avoid misunderstandings and miscommunication during teaching and learning process. The activities in collaboration is an attempt to demonstrate the ability to work effectively and respectfully with diverse teams to achieve common goals with shared responsibility.

Table 3: Comparison of Teaching activities for collaboration between engineering and non-engineering educators

Engineering				**Non Engineering**			
Teaching Activity	f	%	Rank	**Teaching Activity**	f	%	Rank
Peer Partner Learning	92	92		Cooperative Learning	68	68	
Research Project	83	83		Peer Partner Learning	68	68	
Think Pair Share	83	83		Field Trip	67	67	
Field Trip	72	72		Think Pair Share	67	67	
Cooperative Learning	71	71		Research Project	65	65	
Guided Reading	54	54		Heterogeneous Grouping	62	62	
Jigsaw	52	52		Homogeneous Grouping	56	56	
Role Playing	43	43		Computer Assisted	47	47	
Debate	42	42		Jigsaw	45	45	
Interdisciplinary Approach	39	39		Experiments	43	43	

3.1.4 Comparison of Teaching Activities between Engineering and Non Engineering Educators (Creativity)

Creativity is a cognitive concept often linked with creative thinking, imagination and innovation in education. Similar to the aforementioned C's element in 21st century skill, the fourth C's is the creativity. Figure (4) shows the differences in creativity teaching practices employed by engineering and non-engineering educators in technical university. Figure below shows that Research Project (94%) is the highest activity practiced by Engineering educators compared to its other activities, while for Non-engineering shows Mind Mapping (80%) activity reported the highest results compared to its other activities. The findings also indicate that for engineering educators, Modelling (83%) activities have the lowest percentage, while Research Project (69%) activities indicate the lowest results for non-engineering educators.

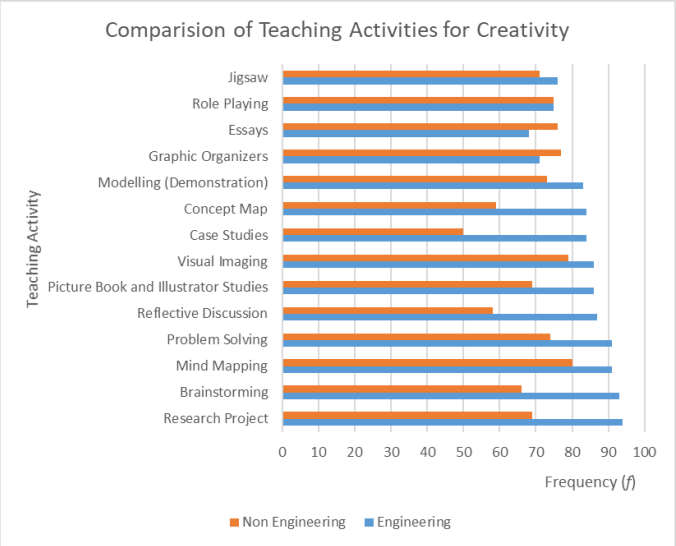

Figure 4: Comparison of Teaching activities for critical thinking between engineering and non-engineering educators (Creativity)

Referring to table 4, there are four teaching method that achieved more than 90% agreement by the engineering educator such as research project (f = 94, 94%), brainstorming (f = 93, 93%), mind-mapping (f = 91,91%), and problem solving (f = 91, 91%). Also, Modelling (Demonstration) (f =83) and Picture Book & Illustrator Studies and Research Project have the same score (f =69) that is the lowest value for both fields of creativity activities within engineering educators.

Besides, for the non-engineering educators there is no teaching elements were agreed reach more that 90%, however, the higher score was obtained in mind-mapping (f =80, 80%). Contradict, the higher agreement score of research project was obtained from engineering educator, while, it is the lowest agreement score for the non-engineering educators. Research project were commonly designed to promote critical thinking, problem-solving, oral communication, investigative, and teamwork skills of students. This project also helps students learn to connect with the community and analyse important issues, problems and ideas. However, research projects are always replacing with the creative project or product development

The teaching activities used on both engineering and non-engineering educators had discrepancies in all evaluated. Some of the elements, however, have completely different approaches that were used in their teaching practices by both fields. For example, Concept Map, Brainstorming, Reflective Discussion, Case Study and Concept Map are favored by engineering educators but not by non-engineering educators. While there are other examples, non-engineering educators choose the Graphic Organizers, Graphic Organizers, Essays, Role Playing and Jigsaw activities, but not for the engineering educators. It shows that there are no similarities in value between both fields. Nonetheless, these results can conclude that the learning activities that used by engineering and non-engineering are differ significantly. By using different activities in creativity can produce an innovative solution from a problem and produce the products as a result of new thinking. Learning skills and learning innovations facilitate mastery of other skills such as the ability to recognize perspectives, communicate ideas, take a creative and relevant action to solve complex problems.

Table 4: Comparison of Teaching activities for creativity between engineering and non-engineering educators

Engineering				**Non Engineering**			
Teaching Activity	f	%	Rank	**Teaching Activity**	f	%	Rank
Research Project	94	94		Mind Mapping	80	80	
Brainstorming	93	93		Visual Imaging	79	79	
Mind Mapping	91	91		Graphic Organizers	77	77	
Problem Solving	91	91		Essays	76	76	
Reflective Discussion	87	87		Role Playing	75	75	
Picture Book and Illustrator Studies	86	86		Problem Solving	74	74	
Visual Imaging	86	86		Modelling (Demonstration)	73	73	
Case Studies	84	84		Jigsaw	71	71	
Concept Map	84	84		Picture Book and Illustrator Studies	69	69	
Modelling (Demonstration)	83	83		Research Project	69	69	

4. Conclusion

The study aimed to understand what teaching activities are used towards developing 4Cs skills. Findings from this research indicate that educators use different teaching activities depending on the specific skills to be developed, students' background and country. Overall, both Malaysian and Indonesia teachers have different skills applied in the process of teaching and learning in promoting their 4Cs skills. Engineering educators show high rankings in active reading in Critical Thinking skills, Peer Partner Learning for Collaboration skills and Research Project for Creativity skills. Other than that, non-engineering educators shows a high ranking in Problem Solving teaching activity in Critical Thinking skills, Cooperative Learning for Collaboration skills and Mind Mapping for Creativity skills. However, for Communication skills show both engineering and non-engineering educators have a high ranking in debate activities.

It supported by the results of researches carried out by [11] and [12] where they found there was relationship between pupils' interest toward learning and 21st century skills. However, there's a different measured in all. Some of the elements have completely different activities which were used by both fields in their teaching practices. This indicates that the value between both fields is not identical. Nonetheless, these findings that suggest that there are →significant differences in the cooperation activities for both areas. The findings are expected to contribute to the preparation of technical university educators towards 21st Century education. Additionally, it also can identify the teaching activities used by engineering and non-engineering technical university educators. The finding indicates that technical educators are moving towards the need of future skills. It is arguably an even more challenging role than being a general education teacher in teaching because its contexts are more varied. It requires expertise in both field which support should be given to all educators in terms of professional development and pedagogical change related to 21st century learning and the promotion of 4Cs skills [27]. Thus, it is in a hope that this study will provides useful data for stakeholders in implementing the

4Cs learning activities approach in the 21st Century education

Acknowledgements

We would like to thank the team of Project grant K135 who participated in this study and also thank to the University Tun Hussein Onn Malaysia for the financial support under the Research Fund Vot. K135 from the Research Management Center (RMC) Universiti Tun Hussein Onn Malaysia (UTHM).

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