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Reviewing the Competence of Architecture Students Regarding Project-Based Learning (PBL) Strategies in Architecture Courses at Universiti Teknologi MARA (UiTM)

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Abstract

The project-based learning (PBL) approach has become increasingly popular in higher education institutions as a strategy that promotes deep learning, critical thinking and problem-solving skills among students. This study focuses on assessing the competence of architecture students towards project-based learning (PBL) strategies in improving the knowledge, skills and attitudes of architecture students at UiTM. Using a quantitative approach with descriptive analysis and inferential analysis of differences, the results of the study show that the average amount of architecture students' competency constructs for project-based learning strategies (PBL) in architecture courses at UiTM reached a high interpretation. In addition, the study found that there was no significant difference in the knowledge, skills and attitudes of architecture students based on gender. Competence in PBL strategy is obtained uniformly among male and female students. The implications of this study have a positive impact on the knowledge, skills and attitudes of architecture students. Focusing on the development of technical and soft skills, curriculum alignment with industry, and increasing positive attitudes towards PBL are the keys to effectiveness. It is necessary to increase the use of PBL with training of teaching staff, provision of resources, and adequate support. Continuous and formative assessment is important in improving the quality of PBL learning at UiTM. As a suggestion for further research, the researcher is advised to conduct a qualitative study to obtain additional information beyond the scope of this study. This study may include aspects of knowledge, skills, and attitudes, aiming to contribute to strengthening student competence through PBL strategies in teaching architecture in the future.

1. Introduction

Project-based learning (PBL) in universities focuses on deep learning, critical thinking, and problem-solving skills. According to Helle et al. (2006), PBL involves the active involvement of students in the planning, implementation, and reflection of projects that foster responsibility for learning. In the field of architecture, PBL allows students to apply theoretical knowledge in real-world projects, improving understanding and mastery of

the course (Mansor et al., 2018). A study by Özkar and Demirkan (2018) shows that PBL in architecture education can improve students' creativity, design thinking, problem solving, and collaboration skills. Project-based learning is also proven to increase the motivation and learning experience of architecture students at university (Petersen & Lazzari, 2019; O'Leary & Diezmann, 2018). Effective implementation of PBL requires the support of the instructor as a facilitator and project leader, ensuring students achieve the desired learning outcomes (Mochizuki, 2019).

This study aims to evaluate the competence of architecture students on project-based learning (PBL) strategies in architecture courses at UiTM. The objective of the study includes the identification of student competencies from the aspects of knowledge, skills, and attitudes through PBL, while evaluating the differences between male and female students. The research questions involve aspects of knowledge, skills, and attitudes of architecture students as well as gender differences like what is the competence of architecture students at UiTM through PBL project-based learning from the aspect of knowledge? what is the competence of architecture students at UiTM through PBL project-based learning from the skills aspect? what is the competency of architecture students at UiTM through PBL project-based learning from an attitude aspect? what is the difference between the knowledge, skills and attitudes of architecture students based on gender?. The scope of this study focused on the assessment of student competence, including academic knowledge, critical thinking skills, communication skills, problem solving, and attitudes towards PBL. The study also focuses on the differences between male and female students in the context of PBL. By analyzing the dimensions of students' knowledge, skills, and attitudes, this study provides a comprehensive view for improving learning strategies in the architecture curriculum at UiTM.

1.1 Architectural Student Knowledge

Architectural students need to acquire academic knowledge through their educational experiences, with the quality of teaching and the expertise of educators significantly impacting the acquisition of academic knowledge (Hattie, 2009). Academic knowledge serves as the foundation for architectural learning, encompassing an understanding of design principles, architectural history, and construction technology (Ching, 2014). Ideas play a crucial role as a bridge between knowledge and creativity in architecture, enabling the innovative application of technical knowledge and creative elements to create dynamic architectural outcomes (Iwamoto, 2009). Knowledge and ideas provide depth and creativity in architectural learning. Knowledge provides the groundwork for understanding fundamental concepts, architectural history, and modern technology (Ching, 2014). Ideas form the starting point for architectural projects, helping to outline direction and give identity to the design (Suhaili et al., 2013). Creative ideas play a role in exploring unconventional concepts and solving architectural problems (Hanson & Hillier, 1984). Freehand sketching is an essential tool for expressing ideas quickly (Lockard, 2007), and the use of technology in freehand sketching requires knowledge of digital technology integration (Laseau, 2017). Specific knowledge is required for the use of technology such as CAD software in building design (Krygiel & Nies, 2014). Knowledge of construction plans, construction techniques, and project budgets is crucial for the success of design (Ching, 2014; Hinze, 2011). The importance of fundamental aspects in implementing architectural projects, including project planning with comprehensive site studies, also needs to be understood by students (Ballast, 2007). The combination of conceptual knowledge and practical creativity shapes high-quality and innovative architectural students.

1.2 Architectural Student Skills

The practical application of theoretical knowledge, as emphasized by Ching (2014) and Iwamoto (2009), is crucial in bridging the gap between theory and practical reality. Through practical experiences, individuals not only apply the learned theories but also strengthen their understanding and enhance proficiency in using theoretical concepts. Practical experiences also stimulate creativity and innovation, enabling individuals to creatively solve problems without being confined to theoretical concepts alone (Suhaili et al., 2013). In the context of architecture, the development of students' skills is essential. The use of various methods, such as sketching skills, physical models, and architectural software, cultivates a diverse set of skills and encourages exploration of different architectural styles (Ching, 2014; Iwamoto, 2009). Technical skills, including proficiency in architectural software and 3D modeling, take precedence in meeting contemporary technological demands (Chen and Wang, 2021). However, beyond technical skills, human skills such as communication, analysis, problem-solving, and collaboration are equally important (Zahid et al., 2019; Hamzah, 2017). The significance of continuous practice and skill development, particularly in freehand sketching, cannot be overlooked in stimulating creativity. It aids in the conceptual development of architectural projects, allowing students to express their ideas freely and creatively (Lockard, 2007; Suhaili et al., 2013). Overall, the practical application of theoretical knowledge forms the foundation for professionalism in the architecture industry, ensuring that theoretical concepts are effectively applied in practical contexts.

1.3 Architectural Student Attitudes

Attitude refers to an individual's overall assessment or feelings towards an object, person, or situation. In the context of architecture students, attitude encompasses their perspectives and feelings regarding their studies, learning, and educational experiences. Studies indicate a positive relationship between students' attitude, academic achievement, and motivation (Wang et al., 1993). The attitude of architecture students plays a crucial role in the outcomes of architectural projects. Research suggests that positive and committed attitudes directly influence project success, with proactive, creative, and collaborative attitudes leading to greater achievements (Abdullah, 2021). Positive, committed, and creative attitudes of students significantly contribute to each phase of architectural projects. Proactive approaches and a willingness to try new methods enhance the quality of the final project outcomes, while a positive attitude towards learning correlates with improved academic success (Rahim, 2018). Students' attitudes also impact their social interactions and well-being. A positive attitude towards peers enhances social integration and cooperation in the classroom (Wentzel, 1997). In architectural projects, collaborative attitudes and mutual trust among team members result in more effective project outcomes (Ali and Sulaiman, 2019). Attitudes towards time management and responsibility play a role in meeting project deadlines. Awareness of time and a respectful attitude towards project schedules contribute to higher interpretations of achievement (Ali, 2021; Tan and Lim, 2019). Attitudes towards the educational process, including perceptions of educators, influence student engagement and satisfaction. A positive attitude towards educators fosters motivation, involvement, and academic success (Van Acker, 2016). Overall, the attitudes of architecture students play a crucial role in academic achievement, project success, social interactions, time management, and satisfaction in the learning process.

2. Methodology

The design of this study uses a quantitative approach through a survey method to collect data related to the competence of architecture students towards project-based learning (PBL) strategies at UiTM. This study involves planning a survey with the use of an online questionnaire as a research tool. This approach was chosen to provide a brief overview of architecture students' behaviors, attitudes, and beliefs. A survey study is suitable for obtaining data from a pre-selected sample, and hopefully provides enlightenment on the topic of the study. In this study, the researcher focused on the student population of Universiti Teknologi MARA (UiTM) and used population sampling techniques. The sampling technique of Krejcie and Morgan (1970) was used. A sample of 262 students was selected at random from the UiTM population of 794 people. Simple random sample selection ensures that each individual in the population has an equal chance of being selected, providing high internal and external validity to the sample. This technique is considered suitable for a variety of research settings without requiring extensive knowledge of the population or complex sampling procedures. Researchers ensure a fair and unbiased selection process by using random sampling techniques.

2.1 Instrument

In this quantitative study, data were collected using a questionnaire as the main research instrument. The items in the questionnaire were designed based on the study's objectives and research questions. Questionnaires are a commonly used tool for data collection in research. The contents of the questionnaire are detailed in Table 1.

Table 1 *Questionnaires contents*

Part	Elements	Number of Item
A	Respondent Demographic Data 1. Gender 2. Campus	2
B	Identifying the competence of architecture students at UiTM through PBL project-based learning from the knowledge aspect.	12
C	Identifying the competence of architecture students at UiTM through PBL project-based learning from the skills aspect.	12
D	Identifying the competence of architecture students at UiTM through PBL project-based learning from the attitude aspect.	10

For the form given to the students, it contains 4 parts which are part A, part B, part C, part D and part D. Part A is about questions about the respondent's personal information which consists of questions related to student demographics such as gender and campus. Sections B, C and D contain 10 -12 questions in each section based on the stated objectives of the study, which are Part B is identifying the competence of architecture students at UiTM through PBL project-based learning from the knowledge aspect. Part C is identifying the competence of architecture students at UiTM through PBL project-based learning from the skills aspect. Part D is identifying the competence of architecture students at UiTM through PBL project-based learning from the attitude aspect.

3. Result and Discussion

A quantitative study investigating a survey of architecture students' competence through project-based learning (PBL) strategies on knowledge, skills and attitudes based on the gender factor at UiTM.

This section is an analysis of respondents' responses to the first research question, which is what is the competence of architecture students at UiTM through PBL project-based learning from the knowledge aspect. There are 12 items built in this construct to answer questions about architecture students' knowledge of project-based learning (PBL) strategies. From the analysis of research question 1, the total mean of the constructs the competency of architecture students at UiTM through PBL project-based learning from the knowledge aspect is 4.09 and is at a high interpretation. Therefore, it can be concluded that architecture students at UiTM have knowledge in implementing PBL project-based learning strategies.

Table 3 *Mean value for knowledge*

No	Elements	Mean, M	Std. Deviation	Interpretation
1.	I have basic knowledge in implementing projects.	4.10	0.67	High
2.	I can recall past information to implement this project.	4.16	0.46	High
3.	I can present interesting and creative ideas to implement projects.	4.22	0.55	High
4.	I can plan various ideas to implement a project.	4.13	0.53	High
5.	I can evaluate ideas that arise from various perspectives.	4.10	0.49	High
6.	I can come up with ideas to implement projects quickly.	3.84	0.71	High
7.	I can translate the ideas I get in graphic form.	4.11	0.66	High
8.	I can translate the ideas I get in verbal form.	3.95	0.64	High
9.	I can identify problems that may arise when implementing a project.	4.10	0.51	High
10.	I have basic knowledge of free sketching to implement projects.	4.28	0.59	High
11.	I have knowledge of using digital software such as (Auto CAD, Sketch Up, Revit and others).	3.97	0.71	High
12.	I can complete projects effectively through the ideas I get.	4.18	0.52	High
	Overall average amount	4.09	0.41	High

(N=262 , Interpretation: Low = 1.00 – 2.33, Medium = 2.34-3.66, High = 3.67-5.00)

Table 4 shows the overall analysis for the second research question, which is to identify the competence of architecture students at UiTM through PBL project-based learning from the skills aspect. There are 12 items used to discuss research questions related to the skills of architecture students. From the analysis of this research question 2, the overall average mean for the competence construct of architecture students at UiTM through PBL project-based learning from the skill aspect is 4.32 and is at a high interpretation result. The findings show that architecture students at UiTM have high skills in implementing PBL project-based learning strategies.

Table 4 *Mean value for skills*

No	Elements	Mean, M	Std. Deviation	Interpretation
1.	I can put into practice the theoretical knowledge learned practically and technically in the project.	4.25	0.54	High
2.	I can communicate well when implementing projects.	4.55	0.56	High
3.	I can cooperate and respond well together with friends and lecturers when implementing projects.	4.57	0.53	High
4.	I can give appropriate feedback to my friends when doing group projects.	4.36	0.52	High
5.	I can design various methods to carry out projects.	4.18	0.49	High
6.	I can combine various methods to implement a project.	4.22	0.49	High
7.	I can detect problems that arise when implementing projects.	4.21	0.48	High
8.	I can make free sketches to implement projects.	4.44	0.53	High
9.	Technological software such as Auto CAD, Sketch Up, Lumion and others help me execute projects quickly.	4.11	0.70	High
10.	I was able to develop the assigned project successfully.	4.27	0.49	High
11.	I can display the results of projects that have been developed.	4.35	0.49	High
12.	I can explain in detail the results of projects that have been developed.	4.38	0.53	High
	Overall average amount	4.32	0.35	High

(N=262 , Interpretation: Low = 1.00 – 2.33, Medium = 2.34-3.66, High = 3.67-5.00)

Table 5 presents the analysis for the third research question, focusing on the attitude of UiTM architecture students in PBL project-based learning. Based on 10 items, the overall mean score is 4.68, indicating a high interpretation of attitude. This shows that the students have a strong positive attitude towards implementing PBL strategies.

Table 5 *Mean value for attitudes*

Part	Elements	Mean, M	Std. Deviation	Interpretation
1.	I care about the progress of assignments and projects.	4.79	0.41	High
2.	I try to complete the project according to the set time.	4.50	0.52	High
3.	I get satisfaction after completing the project.	4.80	0.44	High
4.	I give priority to attending group discussion sessions.	4.67	0.51	High
5.	I reject personal matters if there is a project discussion session.	4.35	0.67	High
6.	I question and answer with the lecturer in the project discussion.	4.63	0.54	High
7.	I concentrate while listening to the explanation from the lecturer.	4.74	0.46	High
8.	I refer to the project guide given before carrying out the assignment.	4.64	0.48	High
9.	I discuss with friends when I face a deadlock while implementing a project.	4.82	0.38	High
10.	I am determined to get excellent results.	4.88	0.36	High
	Overall average amount	4.68	0.31	High

(N=262 , Interpretation: Low = 1.00 – 2.33, Medium = 2.34-3.66, High = 3.67-5.00)

Table 6 show The Independent Sample T-Test was conducted to examine the difference in architecture students' knowledge based on gender. The assumption has been met. Table 6 shows that there is no significant difference between males and females in terms of the perception of architectural students' knowledge when implementing Project-Based Learning (PBL) strategies at UiTM, as the significance value at both ends exceeds p≥ 0.05, i.e., (p= 0.12). The results of the Independent Sample T-Test for both groups indicate that the mean perception of knowledge for male students (M = 4.13) is approximately the same as the mean perception of knowledge for female students (M = 4.06). The difference between the means is very small, i.e., 0.07. The effect size (d) is approximately 0.17, indicating a small effect size for social science effects.

Table 6 *A t-test analysis between the knowledge of architecture students based on gender*

Variables	M	*SD*	*t*	*df*	*p*	*d*
Knowledge of architecture students at UiTM regarding the implementation of PBL strategies			1.57	239.97	0.12	0.17
i. Male	4.13	0.34				
ii. Female	4.06	0.47				

Note: A 2-tailed significant value that exceeds 0.05 (P ≥ 0.05) shows that there is no statistically significant difference.

Furthermore, to examine the difference in skills among architecture students based on gender, an Independent Sample T-Test was also conducted. Assumptions were met. Table 7 indicates that there is no significant difference between males and females in terms of the perception of architectural students' skills when implementing Project-Based Learning (PBL) strategies at UiTM. This is evident from the two-tailed significance value exceeding *p*≥ 0.05, i.e., (p = 0.45). The results of the Independent Sample T-Test for both groups show that the average skill perception for male students (M = 4.31) is approximately the same as the average skill perception for female students (M = 4.34). The difference between the means is very small, specifically 0.03. The effect size (d) is approximately 0.08, indicating a small effect size for effects in the social sciences.

Table 7 *A t-test analysis between the skills of architecture students based on gender*

Variables	M	*SD*	*t*	*df*	*p*	*d*
The skills of architecture students at UiTM towards the implementation of PBL strategies			-0.76	260.00	0.45	0.08
i. Male	4.31	0.33				
ii. Female	4.34	0.37				

Note: A 2-tailed significant value that exceeds 0.05 (P ≥ 0.05) shows that there is no statistically significant difference.

An Independent Sample T-Test was also conducted to examine the difference in attitudes among architecture students based on gender. Assumptions were met. Table 8 indicates that there is no significant difference between males and females in terms of the perception of architectural students' attitudes when implementing Project-Based Learning (PBL) strategies at UiTM. This is evident from the two-tailed significance value exceeding p≥ 0.05, i.e., (p = 0.47). The results of the Independent Sample T-Test for both groups show that the average attitude perception for male students (M = 4.67) is approximately the same as the average attitude perception for female students (M = 4.70). The difference between the means is very small, specifically 0.03. The effect size (d) is approximately 0.10, indicating a small effect size for effects in the social sciences.

Table 8 *A t-test analysis between the attitude of architecture students based on gender*

Variables	M	*SD*	*t*	*df*	*p*	*d*
Attitude of architecture students at UiTM towards the implementation of PBL strategy			-0.72	260.00	0.47	0.10
i. Male	4.67	0.32				
ii. Female	4.70	0.30				

Note: A 2-tailed significant value that exceeds 0.05 (P ≥ 0.05) shows that there is no statistically significant difference.

From the analysis of research question 4, no significant differences were found in the knowledge, skills, and attitudes of architecture students based on gender. The obtained findings suggest that architecture students at UiTM exhibit comparable outcomes in implementing Project-Based Learning (PBL) strategies.

4. Disscussion

The findings of this study indicate that architecture students at UiTM possess a high interpretation of knowledge regarding the implementation of project-based learning (PBL). Foundational knowledge in architecture serves as a cornerstone in the development of creative and innovative ideas. Students are required to master both theoretical and technical elements, such as freehand sketching, which plays a crucial role as a medium for expressing design ideas spontaneously and rapidly. Freehand sketching not only forms the basis of visual communication in architecture but also contributes significantly to the creation of more creative and innovative designs. Moreover, students are not merely implementers but also serve as creative thinkers who contribute to the development of design ideas. This capability reflects their comprehensive understanding and application of architectural principles. It is evident that UiTM architecture students do not only excel in theoretical knowledge but are also capable of integrating this knowledge into real-life project execution. Knowledge and ideas are applied holistically, leading to comprehensive and high-quality architectural outcomes.

The study found that architecture students at UiTM demonstrate a high interpretation of skill in executing project-based learning. Two primary categories of skills were emphasized: technical skills and soft skills. Technical skills include mastery of design principles, software applications, and structural understanding, while soft skills involve communication, teamwork, leadership, and problem-solving. Students' ability to work collaboratively and communicate effectively is a major strength in completing group tasks and producing high-quality architectural projects. Effective communication and teamwork enable students to share perspectives, adapt to different ideas, and resolve conflicts productively. Overall, the study shows that the combination of technical and soft skills is crucial in ensuring student success in the field of architecture. Students who are well-balanced in both aspects are better prepared to face the challenges of the professional world, which demands not only technical proficiency but also strong interpersonal intelligence.

The results of the study indicate that UiTM architecture students have a positive attitude towards project-based learning. This attitude encompasses commitment to tasks, teamwork spirit, and a strong desire for academic excellence. Student attitude plays a vital role in the successful implementation of projects, particularly in a learning environment that emphasizes active student participation. Students who are diligent in completing assignments, willing to work overtime, and do not easily give up tend to produce higher quality work. Additionally, peer discussions strengthen the collaborative learning process, where students exchange ideas and critically refine concepts. A culture of creative and open-minded thinking among students forms the foundation for a healthy learning attitude in architectural education. This study confirms that a positive student attitude in the context of PBL is a key contributing factor to learning success and should be prioritized when planning teaching and learning strategies.

This study also examined gender-based differences in students' knowledge, skills, and attitudes. An independent sample t-test analysis showed no significant differences between male and female students in all three aspects. This indicates that proficiency in project-based learning is equal regardless of gender. While previous studies have suggested that female students may perform better academically, the results of this study

suggest that in the field of architecture, individual ability, rather than gender, determines potential and achievement. This outcome may be attributed to the selective admission process at the faculty interpretation, where only students who meet specific criteria are accepted into the architecture program. The evaluation process, which includes portfolio reviews, entrance exams, and interviews, ensures that only capable and promising candidates are admitted. In conclusion, the equitable and comprehensive student selection process helps ensure that there is no significant gender gap in knowledge, skills, or attitudes. These findings support the argument that success in architecture is more closely tied to talent, passion, and commitment than to gender.

5. Conclusion

This study has elucidated the assessment of architectural students' competence through Project-Based Learning (PBL) strategies concerning knowledge, skills, and attitudes based on the perceptions of architectural students at UiTM. The research findings indicate that architectural students at UiTM master the aspects of knowledge, skills, and attitudes towards PBL strategies. The analysis of the study's findings, namely the overall mean for each aspect studied, is at a high interpretation, based on the established minimum scale values. Among the emphasized aspects in this study are knowledge, skills, attitudes, and gender differences. Although overall interpretations of knowledge, skills, and attitudes of students in this study are at a high interpretation, there is still room for improvement that needs to be addressed by UiTM academics to enhance the learning performance of architectural students. In conclusion, it can be deduced that studies like this need to be continued to make improvements and identify issues related to project-based learning. Moreover, with studies like this, it can assist the leadership and academic staff at UiTM in refining project-based learning strategies in the field of architecture in the future. Therefore, continuous efforts are needed not only from UiTM academics but also from students to strive for the best in improving the quality of architectural project-based learning strategies.

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References

Ballast, D. K. (2007). *Architect's Handbook of Construction Detailing*. Wiley.

Bond, T. G., & Fox, C. M. (2007). *Applying the Rasch Model: Fundamental Measurement in the Human Sciences*. Routledge

Ching, F. D. K. (2014). *Architecture: Form, Space, and Order*. Wiley.

Hadibarata, T., Hidayat, T., & Kwabena, J. (2023). Problem based learning in engineering course in Malaysia. *Acta Pedagogia Asiana, 2*(2), 95–105. https://doi.org/10.53623/apga.v2i2.234

Hanson, J., & Hillier, B. (1984). The Architecture of Community: Some New Proposals on the Social Consequences of Architectural and Planning Decisions. *Architecture and Behavior, 1*(3), 251-273.

Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. Routledge.

Helle, L., Tynjälä, P., & Olkinuora, E. (2006). Project-based learning in post-secondary education: Theory, practice and rubber sling shots. *Higher Education, 51*(2), 287-314.

Hinze, J. (2011). *Construction Planning and Scheduling*. Pearson.

Iwamoto, L. (2009). *Digital Fabrications: Architectural and Material Techniques*. Princeton Architectural Press.

Krejcie, R. V., & Morgan, D. W. (1970). Determining Sample Size for Research Activities. *Educational and Psychological Measurement, 30*(3), 607-610.

Krygiel, E., & Nies, B. (2014). *Green BIM: Successful Sustainable Design with Building Information Modeling*. Wiley.

Lockard, J. (2007). *Freehand Drawing and Discovery: Urban Sketching and Concept Drawing for Designers*. Wiley.

Mansor, A. T., Rahim, A. R. A., & Ibrahim, N. A. (2018). Integrating problem-based learning (PBL) in engineering education: A case study of fluid mechanics course. *International Journal of Engineering & Technology, 7*(3.2), 134-138.

Mochizuki, T. (2019). Roles of teachers in project-based learning. In M. Sato, H. Matsui, & K. Matsui (Eds.), *Project-based learning as a teaching-learning method for the future: Taking Japanese lesson study as a base* (pp. 91-110). Springer.

Muszynska-Lanowy, M. (2021). Technical and soft competencies in teaching architecture in the context of Industry 4.0. *World Transactions on Engineering and Technology Education, 19*, 203–208.

O'Leary, J., & Diezmann, C. M. (2018). Motivation and problem-solving ability in project-based learning. *International Journal of Science and Mathematics Education, 16*(5), 891-908.

Özkar, M., & Demirkan, H. (2018). Project-based learning in architectural education: The impact on creativity and problem-solving skills. *European Journal of Engineering Education, 43*(4), 590-603.
Petersen, S., & Lazzari, M. (2019). A project-based learning approach to architectural education: Evaluating motivation and learning experiences. *Frontiers in Psychology, 10*, 1042.
Samad, N., Harun, H., Jalani, N. H., Amiruddin, M., Ahmad, W., & Pua, P. K. (2014). *Tahap kemahiran insaniah dalam kalangan pelajar kejuruteraan tahun akhir di Politeknik Primier Malaysia*. https://doi.org/10.13140/2.1.4733.1847
Suhaili, P., Ahmad, E., & Ainah, M. J. A. (2015). Soft skills construct for architecture graduate in accordance with industry requirements. *International Journal of Humanities, Arts and Social Sciences*, 1(3), 119-123.
Tan, L. K., & Lim, K. H. (2019). Respect for Project Schedules and Responsibility in Architectural Assignments. *Journal of Architectural Time Management, 16*(2), 78-94.
Tan, L. (2021). *Collaborative cultures of architecture teams: Team learning and reflective practice*. *The Design Journal*. https://doi.org/10.1080/14606925.2020.1864942
Van Acker, R. (2016). Positive Attitude Towards Educators: Impact on Student Motivation and Academic Success. *Educational Psychology Review, 28*(2), 367-386.
Wang, M. C., Haertel, G. D., & Walberg, H. J. (1993). *Educational resilience in inner-city America: Challenges and prospects.* Hillsdale, NJ: Lawrence Erlbaum Associates.
Wentzel, K. R. (1997). Student Motivation in Middle School: The Role of Perceived Pedagogical Care. *Journal of Educational Psychology, 89*(3), 411-419.