JTET

http://penerbit.uthm.edu.my/ojs/index.php/jtet
ISSN 2229-8932 e-ISSN 2600-7932

Journal of Technical Education and Training

Factors Contributing to Students' Attainment in Design and Technology Project Work

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DOI: https://doi.org/10.30880/jtet.2021.13.01.007
Received 08th January 2021; Accepted 22nd February 2021; Available online 31th march 2021

Abstract: Design and Technology (Reka Bentuk dan Teknologi) or known as RBT, is a new subject introduced as part of the Secondary School Standard Curriculum (KSSM) in 2017. The content of this new subject focuses on the daily application of technology, specifically through the implementation of RBT project work. There is a need to assess whether this subject has a positive impact on students' achievement, especially in project work. This study aimed to examine the factors influencing the performance of lower secondary school students in Johor Bahru district in their RBT project work. A total of 374 form three students were selected as a sample using descriptive approach and utilising quantitative research design. A questionnaire was used as the research instrument. A pilot study was conducted, and the result was analysed using the Rasch Measurement Model to determine the validity and reliability of the instruments used. Furthermore, the study's data were analysed using the SPSS 25.0 software. The study found that students' interest (m), attitude (s), knowledge (p), and skills (k) in RBT is at a moderate level with the mean value for each variable for (m) = 2.61, (s) = 2.79, (p) = 2.75, and (k) = 2.73. The Pearson coefficient found a significant relationship between interest, attitude, knowledge skills, and students' academic achievement, where r = 0.543 ($p < 0.05$) for interest, r = 0.568 ($p < 0.05$) for attitude, r = 0.526 ($p < 0.05$) for knowledge, and r = 0.515 ($p < 0.05$) for skills. The results of this study prove the need for a more interactive and effective teaching approach to increase students' interests, attitudes, knowledge, and skills to improve their performance in RBT project work.

Keywords: Students' attainment, design and technology, KSSM

1. Introduction

The Secondary School Standard Curriculum (KSSM) was introduced in 2017 to replace the Integrated Secondary School Curriculum (KBSM). It is part of the government's aspiration to produce a balanced human capital that can address future challenges (Curriculum Development Division, 2015). Among the subjects introduced in KSSM is the Design and Technology (RBT) subject. RBT is a new elective subject for lower secondary students which replaces the Integrated Living Skills (KHB) subject (Curriculum Development Division, 2015). In contrast to KHB, which focus on teaching students the basic knowledge and life skills for their daily life and future employment, RBT emphasises the design and production of technological products. The RBT subject is also aimed to produce students who can create and produce meaningful products (Curriculum Development Division, 2015).

Students' achievement and performance in RBT can be assessed through the quality of their project work. In this regard, the level of students' mastery can be assessed through their knowledge, skills, values, and creativity (Bidin & Mahamod, 2016). The implementation of RBT Form 3 project helps teachers to foresee students' potential as it provides

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students with the opportunities to put forward their ideas and find solutions for the problems they faced in completing the project. Students are also able to use creativity to invent new products or modify existing products to suit their needs. This hands-on, product creation approach is in-line with the concept of 21st century learning (Zulkarnain, Saim & Abd Talib, 2012). According to Hassan (2015), this approach provides students with the autonomy to explore real-world challenges and problems. Students are required to translate ideas, build knowledge, and demonstrate self-efficacy. They also need to focus fully on the work so it could be completed within the given time. The implementation of project work also has a positive effect on students' academic achievement because students can learn and revise topics that they have learned throughout the implementation of this project work. Reports also showed that students have high acceptance of the project work implementation, as it is interesting and engaging for them (Yeop & Gapor, 2013).

The RBT subject in secondary schools have entered its third year of implementation since it was introduced in 2017. Form three students in 2019 were the first group of students to enrol on this subject for their Form Three Assessment (PT3). The RBT Project Work is mandatory for all form three students who enrol on this subject (Curriculum Development Division, 2019). Many things need to be improved in the implementation of RBT project work as it is a newly introduced subject and this was the first time the form three RBT project work was implemented. Preliminary studies were conducted by interviewing three RBT subject teachers from a secondary school in Johor Bahru district. The preliminary study found that teachers and students face several problems throughout the implementation of the form 3 RBT project.

Based on the interviews with the teachers, it was found that some students were not interested and did not show a positive attitude during the implementation of the RBT project work. Students' attitude could affect the implementation of the RBT project; these students did not put in efforts to ideas in implementing the project. In this case, the teachers tried to encourage the students to be involved in the implementation of the project work so that they can complete the project within the allocated time. Quek and Yeo (2006) stated that interest has a positive influence on students' attainment, as it will drive students to implement a task diligently to achieve a satisfactory outcome. However, students with low interest in completing a task will show slow progress and have a less satisfactory result. Students with high interest towards the project will implement it eagerly and able to find their problems that need to be solved on their own, but those with low interest will rely on their teacher to propose ideas for their work.

Apart from students' lack of interest and positive attitude on the RBT project work, the teachers interviewed also shared that the students showed little initiative to think independently and find their own ideas. In this case, the subject teacher has to help students to find ideas and find problems that need to be solved in the product. This problem escalates when the majority of students in the class rely on the teacher to find ideas about their project. The teacher, on the other hand, has to come up with various novel ideas because each student is required to produce different projects to comply with the condition that the project has never been on the market. The teachers interviewed also found that students still have low knowledge and weak understanding of the topics learned as the students face difficulties in recalling the topics learned. This is especially challenging as the RBT project work requires students to apply the technologies they have learned and the processes in the project implementation. Subsequently, the teacher has to take the time to re-explain and give students ideas on topics they can choose to create a project.

Teachers found that problems surfaced at the early stage of the project when students were unable to identify the problems that needed to be solved. This problem caused the implementation of project work to be somewhat disrupted. The students demonstrated weak problem-solving skills as they are reluctant to think for themselves and try to find a problem that needs to be solved in the project. RBT project work requires students to come up with new ideas and innovate. As the 21st century students should not be equated with students from the previous era, these students should have a progressive perspective. The production of products through the RBT work project can show the ability of students as future leaders. However, the lack of attitude, interest, knowledge, and skills among students hinders the achievement of a country's educational aspiration to develop the students' full potential.

Based on the discussion on the study's problems, students were facing issues in completing their Form 3 RBT work project. Some students were not interested in completing the project, which forced the subject teacher to intervene and propose ideas so that the students could complete the project. Some students also did not take the project seriously and refused to cooperate in the implementation of RBT work projects. Teachers also found that the students have low level of knowledge and skills, as they were unable to complete the project successfully. There are lack of studies have been conducted in the context of RBT subject in Malaysia. Therefore, this study was conducted to determine:

i. the level of interest, attitude, knowledge and skills among Form Three students in RBT project work
ii. the correlation between interest, attitude, knowledge and skills towards students' attainment in RBT project work

Meanwhile, the research questions formulated for this study are as follows:

i. What are the level of interest, attitude, knowledge and skills among Form Three students in RBT project work?
ii. Is there any correlation between interest, attitude, knowledge and skills towards students' attainment in RBT project work?

2. Methodology

This research study was carried out in secondary schools in Johor Bahru district of Johor state, Malaysia. A quantitative survey design using a set of questionnaire was utilised in this study to measure the desirable constructs. The survey was conducted after the Form 3 Assessment (PT3). Ethical procedures include informed consent, confidentiality and anonymity were followed accordingly while conducting this research. The study was conducted after the PT3 examination, to avoid the interference with the teaching and learning process.

2.1 Population and Sampling

The population of this study is 9121 form three students in Johor Bahru. Specifically, the students are from government-type daily school who enrolled in the RBT subject and have completed their project work. A total of 370 students were selected to be the respondents for this study (Krejcie and Morgan, 1970), selected based on simple random sampling technique.

2.2 Instrument

The questionnaire used in this study consists of two sections, namely Section A for demographic information and Section B for the scaling items that need respondents to assess it. Section A is needed to obtain background information of the respondents, including gender and race. The respondents' result in their PT3 trial examination is used to indicate their attainment in RBT project work. Meanwhile, the questionnaire items in Section B consists of 46 items using a four-point Likert scale adapted from previous studies. The items to measure Interest in the questionnaire were modified from the research questionnaire of Royo and Mahmood (2011). On the contrary, items to measure "Attitude" were modified from Basir, Hamza & Abdul Razak (2017) and Kassim, Damit & Taat (2017), while the items to measure "Knowledge and Skills" were modified from the Form 3 RBT project evaluation rubric issued by the Curriculum Development Division (2019). In the context of this study, the "Knowledge and Skills" are not measured using performance test and observation but was measured through the self-reflection perception.

The researcher conducted pre-tests among ten students who have the similar characteristics to the sample as part of face validation. The students were asked to read and evaluate the level of readability and comprehension of the questions in the questionnaire. A pilot study was conducted to ensure the accuracy of the questionnaire items based on the content, clarity, and reliability of each item. A pilot study helps to identify the optimum method in administering a study, select a sample, and estimate the appropriate time of completion before the actual study could be conducted (Mohd Najib, 1999; Mohd Najib, 2011).

The researcher conducted a pilot study on 40 students of form three enrolled in the RBT subjects and completed their RBT project work. The data from the pilot study were analysed using Statistical Package for Social Sciences (SPSS) Windows Version 25.0. The data were then tested using statistical tests including the Rasch Measurement Model conducted through the Winstep application. Table 1 shows the summary from reliability index on each construct based on the pilot study conducted.

Table 1 - Reliability index on each construct measured using the instrument

Aspect	Interest	Attitude	Knowledge	Skills
Cronbach's alpha reliability*	0.85 (High)	0.85 (High)	0.73 (High)	0.81 (High)
Person reliability**	0.82 (Good)	0.82 (Good)	0.70 (Fair)	0.77 (Fair)
Item reliability**	0.82 (Good)	0.83 (Good)	0.85 (Good)	0.77 (Fair)

*indicator based on Gay, Mills and Airasian (2012) **indicator based on Fisher (2007)

2.3 Data Analysis

To answer the first research question, the form three students' level of interest, attitude, knowledge, and skills pertaining to RBT project work were interpreted based on the mean interpretation scale comprising of four scales. In this light, the researcher was guided by the mean score evaluation used by (Ghani Taib, 1996; Mohd Sahandri, et. al., 2013). On the contrary, The Pearson correlation was used to see the direction of the relationship and the strength of the relationship between interest, attitude, knowledge and skills towards students' attainment in RBT project work. Table 2 shows the mean score interpretation and Pearson correlation coefficient used in this study.

To verify whether parametric test could be conducted, normality test by using skewness analysis was performed, Table 3 shows that the values of skewness for all constructs are in the range from -.898 to -.578. The value was in the range +/-1 which verified the normality of the data (Hair, et. al., 2017). Therefore, parametric analysis could be performed to the data set.

Table 2 - Mean score interpretation and pearson correlation coefficient

Mean Score	Interpretation	Pearson correlation (r)	Significant
		0.10-0.20	Very weak
1.00 – 2.00	Low	0.21-0.40	Weak
2.01 – 3.00	Moderate	0.41-0.70	Moderate
3.01 – 4.00	High	0.71-0.90	Strong
		0.91-1.0	Very strong

Table 3 - Result of normality test

Construct	Skewness
Interest	-.578
Attitude	-.898
Knowledge	-.648
Skills	-.595

3. Findings

The data from section A were analysed to determine the respondents' background. Frequency values were used to obtain information. The students' academic achievement was measured based on their RBT marks and grade marks obtained in their Form 3 Assessment Trial Examination. The finding from demographic background shows a balance gender percentage among the respondents, with 50.3% respondents are male (N=188) and 49.7% are female (N=186), accumulating a total of 374 respondents. Meanwhile, majority of the races among the students are Malay with 52.9% (N=198), 36.9% are Chinese (N=138), 5.9% are Indian (N=22) while the remaining 4.3% are others (N=16). The percentage of respondents obtaining grade A in their PT3 trail examination is 0.5% (N=2), while 6.1% obtain grade B (N=23), 14.2% obtain grade C (N=53), 16.3% obtain grade D (N=61), 15.5% obtain grade E (N=58) and a large 47.3% obtain grade F (N=177).

The first descriptive analysis from Section B is related to the respondents' interest towards RBT project work. The highest mean was recorded by the item "*I had fun completing my RBT project work with my friends*" with mean 3.07, recorded at the moderate level of interest. Meanwhile, the lowest mean was recorded by the item "*I'm interested in RBT project work because the source of references are easily available*" with mean 2.40, classified as low level of interest. The second findings from Section B is related to the respondents' attitude towards RBT project work. The highest mean was recorded by the item "*I work hard to obtain outstanding result in RBT project work*" with mean 3.02, recorded at the moderate level of attitude. Meanwhile, the lowest mean was recorded by the item "*I studied the topic involved before completing the RBT project work*" with mean 2.60, classified as moderate level of attitude.

Next, the descriptive analysis from section B is related to respondents' knowledge toward RBT project work. The item "*I can make a list of materials and equipment to be used in RBT project work*" recorded the highest mean of 2.88, corresponds to a moderate level of knowledge. On the contrary, the item "*I know the technology application needed to be used in solving problem related to RBT project work*" recorded the lowest mean of 2.68, still classified as moderate level of knowledge. The final descriptive analysis from Section B is related to respondents' skills towards RBT project work. The highest recorded mean is from the item "*I can make improvements to the product in my RBT project work based on the suggestions given*" with mean score of 2.85 at moderate level of skills. Meanwhile, the item "*I can solve problem arises during the completion of my RBT project work*" recorded the lowest mean of 2.61, indicating a moderate level of skills.

Table 4 indicates that all four construct are at moderate level. The level of interest towards RBT project work among Form Three secondary school students in Johor Bahru is at a moderate level with the mean of 2.61. Similarly, the attitude of form three secondary school students in Johor Bahru towards RBT project work is at a moderate level with the mean of 2.79 and their level of knowledge of RBT project work is at a moderate level with the mean of 2.75. Lastly, the level of skills in RBT project work among Form Three secondary school students in Johor Bahru is at a moderate level with the mean of 2.74.

Meanwhile Table 5 shows the results of the null hypothesis. There were four null hypotheses tested using the Pearson Correlation. All hypotheses were measured at the significance level of $p<.01$. The results of the analysis found that all null hypotheses are rejected because there is a significant relationship between items on interest, attitude, knowledge, and skills with students' attainment in RBT project work. The results show that there is a significant positive relationship between students' interest and academic achievement ($p<.01$). The results obtained show a moderate correlation between both variables with $r(368) = .543$, $p = .01$. The result also indicates there is a significant positive relationship between attitude and students' academic achievement ($p<.01$), indicating a moderate correlation between both variables with $r (368) = .568$, $p = .01$. Furthermore, there is a significant, positive relationship between knowledge and academic

achievement (p<.01) with a moderate correlation between both variables with r(368) = .526, p = .01, and significant positive relationship between skills and academic achievement (p<.01) with weak correlation between both variables with r (368) = .515, p = .01.

Table 4 - Descriptive analysis for all four constructs measured

Research Question	Average mean	Level	No. of measuring item	Range of mean value
What is the level of interest towards RBT project work among form three students in Johor Bahru?	2.61 (0.576)	Moderate	17	2.40 – 3.07
What is the level of attitude towards RBT project work among form three students in Johor Bahru?	2.79 (0.600)	Moderate	16	2.60 – 3.02
What is the level of knowledge of RBT project work among form three students in Johor Bahru?	2.75 (0.594)	Moderate	7	2.88 – 2.68
What is the level of RBT project work skills among form 3 students in Johor Bahru?	2.74 (0.596)	Moderate	6	2.85 – 2.61

Table 5 - The result of null hypothesis

No	Hypothesis	r	p	Result
Hol 1	There is no significant relationship between the interest of form three students in Johor Bahru towards RBT project work and their academic achievement	0.543**	p=.00<.01	Rejected
Hol 2	There is no significant relationship between the attitude of form three students in Johor Bahru towards RBT project work and their academic achievement	0.568**	p=.00<.01	Rejected
Hol 3	There is no significant relationship between the RBT project work knowledge of form three students in Johor Bahru and their academic achievement	0.526**	p=.00<.01	Rejected
Hol 4	There is no significant relationship between RBT project work skills of form three students in Johor Bahru and their academic achievement	0.515**	p=.00<.01	Rejected

4. Discussion

The study's finding shows that the form three students in Johor Bahru secondary schools have moderate interest towards the RBT project work. The highest mean score proved the positive role of peer motivation for them to complete their project work. Veronneau and Dishion (2011) study stated that peer interaction has a significant effect on a student's academic achievement and their peers' academic achievement. This is also supported by Nursuhaili (2010) that peer interaction have strong influence on an individual which could drive them in completing their task. In others hand, the moderate level of interest among students due to the opportunity given to them to throw out their creative idea on the project work. Nasyimah (2016) stated that students are more interested in class if they are given the opportunity to solve a problem given critically and innovatively. Furthermore, Yaapar, Sipon and Mohd Daud (2013) found that students are interested in a learning when they find that the lesson is engaging. Students will also be interested in a subject when they feel the topic is meaningful and important to them. It was also found that students have higher interests towards subjects that offer hands-on experience, skills and use of real equipment as it creates a meaningful and engaging experience. This shows that interest plays an important role in the learning process. Zakaria and Rahman (2019) also found that students have high interest in the Business subject as it involves project-based learning. This allows students to discover their talents and create something new. Another study done by Ismail and Mahamod (2016) found that students enjoy learning something that requires them to think critically to solve a problem.

Yaapar, Sipon and Mohd Daud (2013) found that students have high interest towards technical and vocational education. Female students have high perception of technical and vocational subjects because these subjects allow them to highlight their creativity. Royo and Mahmood (2011) involved students taking the design subject and found that students are interested in learning the subject because they like to give creative ideas while learning the subject. The results of the study found that the level of students' knowledge of RBT project work is at a moderate level. As stated in the KSSM RBT Form 3 Project Work Guideline, students need to list the materials and equipment to produce a product. This step is important to ensure that the students do not face further problems while implementing the project.

This study also found that students have a moderate RBT skill, in line with the findings of Muda and Mohamad (2013) study which involved 120 students from Community Colleges. The study also found that students' skills is at a moderate level. The item on skills with the highest score is "*I can make improvements to the product in my RBT project work based on the suggestions given*". In this light, after the product has been evaluated, suggestions for improvement will be put forward to the students so that the product will be functional and useful. These findings show that students have made improvements to the product based on the suggestions for improvement. According to Dazali and Awang (2014), good communication skill includes the ability to produce effective write-ups that could be easily understood by others. A study by Azli and Jambari (2017) also proved that communication skills is essential, especially for engineering students in university level to convey the idea of their project properly. Writing a project report is the last stage in the project work and the teacher will guide the students to document their project effectively to obtain a good mark. The results of this study show that students are able to produce the report. Students' mastery of communication skills (soft skills) and technical skills is essential for healthy competition among them (Rosly et al., 2020). This is because 21st century learning requires students to be actively involved and share their opinions and convey the information they acquired from the lessons.

The descriptive findings clearly show that the level of interest, attitude, knowledge and skills among form three students need to be considered when preparing teaching material. Different individual have different learning style, and there is no one method that could fit all. Diversified teaching approach and teaching material could boost their interest in RBT project work, and embedding peer learning could boost their attitude in performing better in RBT project work. Giving them the opportunity to explore and design their own creative idea could also improve their knowledge and skills in performing RBT project work.

The null hypothesis was rejected because the findings showed that there is a significant relationship between students' interest towards RBT project work and their academic achievement. Royo & Mahmood (2011) also found the positive relationship between students' interest in the Fundamental of Business subject and their academic achievement. Abu and Eu (2017) study involved form four students taking the additional mathematics subject and showed that interest has a significant relationship with student achievement. Meanwhile, there is a positive relationship between students' attitude towards RBT project work and their academic achievement. Based on this result, the null Hypothesis is rejected. Similarly, a study by Abu & Eu (2017) which involved form four students taking the additional mathematics subject showed that attitude has a significant relationship with student achievement. Similarly, Basir, Hamza & Abdul Razak (2017) study on 200 polytechnic students found that students' attitude towards project work is high. The study found that environmental and peer factors are most significant on students' achievement.

The findings of the study indicate a significant, moderately strong relationship between students' knowledge and their attainment in RBT project work. The null hypothesis is rejected because the findings show that there is a significant relationship between students' knowledge in implementing their RBT project work and their academic achievement. Ahmad (2013) conducted a study on fourth year university students taking the machine mechanics subject found a significant relationship between knowledge and students' academic achievement. The study contradicts with the finding of Yeop and Gapor (2013) who reported that there is no difference between the knowledge of students conducting project-based activities.

The final null hypothesis is rejected because the findings show that there is a significant relationship between students' skills in implementing their RBT project work and their academic achievement. The results of this study are in line with the results of the study of Zakaria and Rahman (2019) who found that the level of student skills helps improve student achievement. This finding is also in line with a study by Shah et al. (2017) which found a significant relationship between skills and academic achievement among students in teacher training institutes.

Implementation of RBT Project Work is a student-centred teaching and learning approach. To complete their RBT project work, students are not only required to create meaningful projects but students need to go through steps and procedures that allow them to translate knowledge and apply skills while developing other skills. The implementation of this RBT project work will be more meaningful if students have a high level of interest and attitude towards the project. The positive attitude demonstrated by the students in carrying out their RBT project work should be nurtured from the very beginning and it will be ingrained in them. The students' level of knowledge is reflected through their ability to remember and apply the knowledge learned. Hence, students with limited knowledge should be supported to improve their knowledge. Skills also play an important role in carrying out the project work successfully. The application of technical and generic skills will be evaluated as part of the RBT project work. Hence, students' skills need to be nurtured from the beginning so they can become capable individuals in the future. These four aspects attribute to the learning outcomes required by the students to fulfil the country's aspiration to produce high quality human capital.

5. Conclusion

Based on the results on the level of interest, attitude, knowledge and skills pertaining to RBT project work among form three students in Johor Bahru secondary schools and the relationship between these four aspects with academic achievement, there are several suggestions proposed to reduce problems faced and further improve students' ability in carrying out RBT project work. The Ministry of Education Malaysia, especially the Technical and Vocational Education Division can organise courses on RBT project work for RBT teachers and students to increase students' interests, attitudes,

knowledge and skills. Apart from that, the MOE can also provide sufficient resources and budget allocation to schools, specifically to cater for the students' needs.

Schools play crucial role in implementing programs and activities that could improve students' interest toward learning. A school can organise motivational talks or study tours to technology-based companies, factories, or plants to expose them to the real work application of technology. The school's administrators and the RBT panel need to discuss the equipment and materials students need to complete the project. A school should have the adequate and the latest equipment to keep up with the advancement of technology. RBT workshops should also be well organised, maintained and decorated. Therefore, teachers need to prepare themselves with the knowledge and skills related to RBT project work. Teachers should master the subject's contents and attend courses and training to refresh their knowledge. Teachers should also have good pedagogical knowledge so that they can use the most effective teaching method. They also need to plan their lessons carefully and creatively to arouse interest among students, for example, by applying the Conceive-Design-Implement-Operate (CDIO) framework (Jambari et al., 2018). Teachers should also always be sensitive to the latest developments and act as mentors and motivators to encourage the students.

Students also need to cultivate high interest towards RBT project work. This is because a high interest in project could guarantee an excellent project outcome. Students can also cultivate a positive interest and attitude towards RBT project work by constantly reading and watching technology-based materials and references, which later on will contribute to multiple intelligence build up in their personality to excel well in higher education (Wan Nazri et al., 2019). They can also participate in various creative and innovative activities and keep updated with the latest development in technology. At the same time, students need to prepare themselves adequately before carrying out RBT project work. They need to first review the topics they have learned, make observations, surveys and identify real problems in their daily life before choosing the topic for the project work. In addition, students should also strengthen their knowledge and skills on all aspects related to RBT project work. Again the backdrop, this study hopefully can be as a guideline to relevant parties especially in the context of RBT project work.

Acknowledgement

The authors want thank all the respondents for this study to given information needed. The authors also would like to thank the Ministry of Higher Education, Malaysia, and Universiti Teknologi Malaysia (UTM) for their financial support through Fundamental Research Grant Scheme (FRGS) with vot.no R.J130000.7853.5F083.

References

Abu, N. E. B., & Eu, L. K. (2017). Hubungan antara sikap, minat, pengajaran guru dan pengaruh rakan sebaya terhadap pencapaian matematik tambahan tingkatan 4. *JuKu*: *Jurnal Kurikulum & Pengajaran Asia Pasifik*, 2(1), 1-10

Ahmad, A. M. (2013). Faktor yang mempengaruhi perbezaan pencapaian akademik pelajar lepasan diploma politeknik dan matrikulasi terhadap subjek kejuruteraan (*Doctoral dissertation*, Universiti Tun Hussein Onn Malaysia)

Azli, N. A., & Jambari, H. (2017). Quality of Engineering Graduates of a Malaysian Public University. In 2017 *7th World Engineering Education Forum (WEEF*) (pp. 420-423). IEEE

Basir, N. K., Hamza, M. I. & Abdul Razak, K. (2017). Sikap dalam Pembelajaran Berasaskan Projek Terhadap Pencapaian Pelajar di Politeknik Perak. *Tinta Artikulasi Membina Ummah.* 3(1), 1-14

Bidin, N., & Mahamod, Z. (2016). Readiness of Secondary School Students on the Implementation of School Based Assessment in Malay Language Subject). *Jurnal Pendidikan Bahasa Melayu*, 6(1), 64-76

Curriculum Development Division (2015). *The Secondary School Standard Curriculum (KSSM) for Design and Technology (Reka Bentuk dan Teknologi) Form 1*. Ministry of Education, Malaysia

Curriculum Development Division (2019). *Guideline of Project Work Implementation in Design and Technology for Form Three*. Ministry of Education, Malaysia

Dazali, N. S. M., & Awang, M. I. (2016). Tahap kemahiran komunikasi dalam kalangan pelajar sarjana muda pendidikan IPTA di utara semenanjung Malaysia. *Jurnal Pendidikan Bahasa Melayu*, 4(2), 44-56

Fisher, W. P. (2007). *Rating Scale Instrument Quality Criteria*. Rasch Meas. Trans., 21(1), 1095

Gay, L. R., Mills, G. E., and Airasian, P. (2012). *Educational Research Competencies for Analysis and Application,* vol. 1

Ghani Hj Talib (1996). Pembinaan Instrumen: Ceramah Kursus Penyelidikan Pendidikan Anjuran Bahagian Pendidikan Guru, Kementerian Pendidikan Malaysia, 12-13 Ogos 1996

Hassan, M. (2015). Keberkesanan Pembelajaran Berasaskan projek terhadap pencapaian pelajardan kemahiran abad ke-21 dalam pembelajaran Biologi (*Master dissertation*, Universiti Kebangsaan Malaysia)

Ismail, N., & Mahamod, Z. (2016). Attitude and Readiness Secondary School Students on Higher Order Thinking Skill in Malay Language Literature Component). *Jurnal Pendidikan Bahasa Melayu*, 6(2), 59-67

Jambari, H., Razali, N. A., Taman, I., Noh@Seth, N. H., Osman, S., Ahmad, J., Mohamad Nordin, N. & Rameli, M. R. M. (2018). Conceive-design-implement-operate (CDIO) approach for an innovative capstone project. *Journal of Technical Education and Training*, 10(2)

Kassim, N., Damit, S. A. & Taat, M. S. (2017). Pengaruh Sikap Pelajar dengan Pengajaran Guru Terhadap Penguasaan Bahasa Arab dalam kalangan pelajar PPIB, UMS. *Jurnal 'Ulwan*. 1, 125-142

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and psychological measurement*, 30(3), 607-610

Mohd Najib (1999). Penyelidikan pendidikan. Skudai: Universiti Teknologi Malaysia

Mohd Najib, A. G. (2011). Pembinaan dan Analisi Ujian Bilik Darjah. Johor Bahru: Penerbit Universiti Teknologi Malaysia Press

Mohd Sahandri, G. H., Laily, P., Sharifah Azizah, H., & Mohd Faizal Nizam, L. A. (2013). Buku Panduan Pembinaan Instrumen- Anda dan Kepenggunaan. Tanjung Malim, Perak: Emeritus Publications

Muda, M. & Mohamad, F. (2013). Sikap, Kemahiran Dan Masalah Penggunaan Komputer Di Kalangan Pelajar Kolej Komuniti Kuala Terengganu, Paper Presented in Persidangan Pendidikan (Penyelidikan dan Inovasi) Dalam Pendidikan Dan Latihan Teknikal Dan Vokasional Cie-TVET 2013

Quek, M. L., & Yeo, K. J. (2006). Pengaruh Rakan Sebaya Dengan Pencapaian Matematik Di kalangan Pelajar Tingkatan Empat Di Daerah Batu Pahat, johor (Doctoral dissertation, Universiti Teknologi Malaysia)

Rosly, M. H., Mohd Ahyan, N. A., Noh@Seth, N. H., Jambari, H. & Pairan, M. R. (2020). Study on the Employability of Graduates from Bachelor of Technology with Education through the Graduates Perceptions. *Journal of Critical Review*. 2394-5125, 7(16), 690-698

Royo, M. A., & Mahmood, H. (2011). Faktor-faktor kelemahan yang mempengaruhi pencapaian cemerlang dalam mata pelajaran Reka Cipta. *Journal of Education Psychology and Counseling*, 2, 145-174

Shah, K. M., Mukhtar, F., Abdullah, H., Malek, M. A., & Shukur, Z. M. (2017). Kemahiran Generik dan Pencapaian Akademik dalam Kalangan Guru Pelatih di Institut Pendidikan Guru Malaysia. *Malaysian Journal of Education* (0126-6020), 42(1)

Véronneau, M. H., & Dishion, T. J. (2011). Middle school friendships and academic achievement in early adolescence: A longitudinal analysis. *The Journal of early adolescence*, 31(1), 99-124

Wan Nazri, W. N. A., Saidi, S., Noh@Seth, N. H., Pairan, M. R., Jambari, H. & Mohd Ahyan, N. A. (2019). Multiple Intelligence Focusing on Practical Subjects among Final Year Students of School of Education, Universiti Teknologi Malaysia. *International Journal of Engineering and Advanced Technology IJEAT*. 8 (5C), 498-502

Yaapar, S., Sipon, M. & Mohd Daud, S. (2013) Kesediaan pelajar Kolej Komuniti Selayang dari aspek minat dan sikap terhadap bidang kemahiran pendidikan teknik dan vokasional (PTV) dalam Sistem Modular Kebangsaan. In: Graduate Research in Education Seminar (GREduc 2013), 1 Dec. 2013, Faculty of Educational Studies, Universiti Putra Malaysia. (pp. 613-629)

Yeop, M. A., & Gapor, A. L. (2013). *Kesan pendekatan pembelajaran berasaskan projek berteraskan teknologi terhadap pencapaian dan penerimaan pelajar* (Doctoral dissertation, Universiti Pendidikan Sultan Idris)

Zakaria, I., & A. Rahman, R. S. A., (2019). The Attitudes, Interest and Entrepreneurship Effectiveness on Form Four Students base Business Subject Achievement in The Federal Territory of Labuan. *Journal of Humanities Language, Culture and Business*, 3(12), 115-124. Universiti Kebangsaan Malaysia

Zulkarnain, Z., Saim, M., & Abd Talib, R. (2012). Hubungan antara minat, sikap dengan pencapaian pelajar dalam kursus CC301–Quantity Measurement. *Politeknik Port Dickson*