

Technical Skills of Design and Technology Teachers

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ABSTRACT

Technical skills involve the knowledge and mastery of a particular field especially in areas that deal with methods, process, procedures and techniques. This research was carried out to determine the degree of knowledge, skills, and constraints of the teachers in the subject of Technical Skills in Design and Technology, Electrical and Electronics. A quantitative survey was the research methodology that was adopted in this study. The sample size of this study was 160 teachers of secondary schools in the southern region of Malaysia. The questionnaire consisted of 21 questions in a 5-point Likert scale. The suitability of the questionnaire developed was identified by carrying out a pilot study. The findings of the pilot study revealed that the reliability that was derived out of the Alpha value of Cronbach was 0.94. The Statistical Package of the Social Sciences was used to analyse the data and provide the frequency, percentage, standard deviation and mean scores value. The results revealed that the level of mean is high in all the variables with the level of knowledge of the teachers having a mean of 3.86 and a standard deviation of 0.95, the level of technical skills of the teachers having a mean of 3.87 and a standard deviation of 0.98 and the constraint the Design and Technology (RBT) teachers face having a mean of 4.82 and a standard deviation of 0.40. The overall findings are that Technical Skills with the Design and Technology subject in the Electrical and Electronics subtopic is at high level with a mean score of 4.82 and standard deviation of 0.40. This implies that teachers have good background knowledge in Electrical and Electronics subtopic, but they might be having challenges in implementing the knowledge to practical context because of some limitations.

Keywords: Abilities, Technology, Knowledge, Electricity, Electronics.

INTRODUCTION

Design and Technology (RBT) is a subject that was already taught in the Primary School Standard Curriculum (KSSR) as early as Primary School Level 2 (KPM, 2015). This subject extends to Secondary School Standard Curriculum (KSSM), but with a new name of Integrated Living Skills (Kemahiran Hidup Bersepadu, KHB) subject beginning in 2017 (KPM, 2016). The RBT subject is concerned with design methodology to manufacture simple, convenient, and practical products that are based on technology. To meet the targeted aims and objectives, teachers have the duty of ensuring that they meet the policies of the curriculum. Hence, educators need the knowledge and skills that will enable the smooth running of the teaching and learning (T&L) process (Azizi, 2019; Endot et al., 2021). Design and Technology (RBT) under subtopic of Electrical and Electronics is a handy discipline in the present-day technology era. It entails planning, building, and maintenance of electrical and electronic systems to fulfil the daily needs of the users. Electrical and Electronics need to be studied as well and good technical skills should be possessed in order to enhance technology and come up with new inventions.

According to the student, good teacher traits include proficiency in numerous fields, profound subject-related knowledge, effective use of teaching time, and the use of the most recent technology (Bullock, 2015). With proper learning and teaching of electrical and electronics, one can design and make electrical circuit successfully. The learning process will also enable one to master and translate schematic drawings into pictorial drawings and

vice versa on doing project work. Teaching aids like circuit simulation software is also quite significant and it can be used in modern day technological advancement.

Moreover, communicative skills are not left out either, and it is a priority towards success in the Electrical and Electronics subtopic of Design and Technology. Technical reports and documents are also necessary features allowing the clarity of form so that the exchange of ideas could take place. It is also evident that technical skills allow one to recognize, comprehend, and apply what has been interpreted during this Design and Technology subject that provides extensive possibilities with developments in electrical and electronic technology (International STEM Journal, 2024).

Problem Background.

Creativity is a crucial skill in the 21st century that ensures that different ideas are created to address new and old problems (Lucas, 2016). Design and Technology (RBT) in electrical and electronic field plays a vital role in the advanced development of technology which is still going on. A number of problems and issues should be considered. Most of the teachers might not be well versed in the fundamentals of Electrical and Electronics principles like current, voltage, resistance and circuits. This may cause them to fail to clarify these concepts properly and effectively to students (International STEM Journal, 2024).

Design and Technology focus on knowledge, skills and work processes towards production of projects in the learning process (Kementerian Pendidikan Malaysia, 2019). Learners taking Design and Technology in KSSR have been exposed to the designing and utilizing the prevailing materials and technology in making projects to a greater extent. Circuit assembly, soldering, and testing of electronic components are practical aspects that need to be taught when teaching electrical and electronics. Nevertheless, not every teacher possesses the enough practical skills or experience, and the teaching of this subtopic becomes more difficult, particularly in the schools with not many facilities (International STEM Journal, 2024).

The Teaching and Learning (T&L) process presents a challenge to teachers that they lack knowledge as to when and how to practically encourage creativity (Cropley and Cropley, 2009). The teachers are not always knowledgeable enough with access to the skills necessary to teach electrical and electronic skills, which leads to the lower level of self-confidence (Endot et al., 2021). Moreover, learning resources and equipment are also limited. Most teachers experience shortage of equipment and materials. They can be in the form of circuit boards, simple electrical components and testing equipment such as multimeter. This does not allow them to undertake important practical demonstrations and project-based learning efforts required to learn this subtopic (Ahmad et al., 2019). Moreover, most teachers are not getting advanced training or assistance of experts in electrical and electronics, a factor that makes them to have challenges in improving their competency. Teachers can be trained in the most up-to-date skills and knowledge of this area with the help of comprehensive training programs and industry guidance. Afterward, the implementation of digital instruction technology, including circuit simulation software such as Tinkercad, allows teachers to implement virtual learning on electricity and electronics. Nevertheless, in the absence of knowledge about how to apply this application, teachers can miss the chance to make teaching more interesting and efficient (Endot et al., 2021).

Background of Problem

Skills represent a highly significant creativity in the 21st century that produces different ideas to address novel and older problems (Lucas, 2016). The use of RBT in Electrical and Electronics is essential in establishing more advanced technology. A number of issues and challenges should be taken care of. A lot of teachers might lack a solid knowledge in the rudimentary electrical and electronic knowledge like current, voltage, resistance, and circuitry. This may cause them to be unable to state these ideas clearly and correctly to the students. Design and Technology learning process focuses on the aspects of knowledge, skills, and work steps towards producing a project. The features of designing and working with existing materials and technology will be more familiar to students who study Design and Technology as a part of KSSR when creating projects (Kementerian Pendidikan Malaysia, 2019). Electrical and Electronics teaching involves practical elements like electrical circuit assembly, soldering and electronics components testing. Nevertheless, not every teacher possesses enough practical skills

and experience, and the teaching of this subtopic may be more difficult, in particular, in schools with fewer means.

According to Cropley and Cropley (2009), teachers find the Teaching and Learning at Home (PdPr) process very challenging to produce ideas due to the fact that they will be less cognizant of the timing and manner in which they should promote creativity in practice. Teachers themselves are also ignorant, and they have not been well exposed to the capabilities to teach the skills of electricity and electronics, and have less self-confidence. Moreover, learning resources and tools are also limited. Lack of equipment and material is a problem to many teachers. Such items are circuit boards, simple electrical components, and testing equipment such as multimeter. This does not allow them to use practical demonstrations and project-based learning exercises that are crucial in conceptualizing this subtopic (Ahmad et al., 2019).

Also, most teachers are not provided with any further training or guidance by specialists in the field of Electrical and Electronics which makes them struggle with the task of improving their competency. The industry can provide extensive training programs and guidance to the teachers on how to acquire the best skills and information in this area. Furthermore, is the digital teaching technology. Teachers can introduce a virtual learning of Electrical and Electronics with the help of circuit simulation technology such as Tinkercad. Nevertheless, in the absence of information on the application in teaching, the teachers can fail in the chance to make the teaching process more engaging and participatory.

Objectives

The study objectives are to:

- a. Determine the knowledge level of RBT technical skills teachers on the subtopic of Electrical and Electronics.
- b. Determine the technical skills level of RBT teachers in Electrical and Electronics subtopic.
- c. Determine the constraints of RBT teachers in the sub topic of Electrical and Electronics.

METHODOLOGY

The research design employed in the study is the quantitative survey work. Considering the title of the article RBT Technical Skills for Electrical and Electronic subtopic, a quantitative method is applied to gather the structured information which can be statistically analysed. An instrument of the survey in the form of questionnaire is administered with data gathered on the respondents. The information received is prerequisite on statements and records of the respondents who completed the information on the distributed questionnaire form. Fowler (2021) also supports this, stating that the survey method is a study that implies the collection of data during a specific time, which is typically conducted with the help of a set of questionnaires as the study tool. The research area includes the secondary schools of the Southern Zone in Malaysia, who has been teach the electrical and electronics subtopic. The samples include the teachers in secondary schools, who teach the Design and Technology subject. In this respect, sampling was done in order to consider secondary school teachers only. The respondents were a total of 160 teachers.

FINDINGS

The statistical software IBM SPSS Statistics version 27 (Statistical Package of the Social Sciences) was used in analysing the obtained data in order to answer research questions of the given study. The given analysis is shown according to every part of the questionnaire. The obtained percentages and mean values were analysed using the mean values. The level of knowledge in technical work of Design and Technology in the Electrical and Electronics subtopic: section B is analysed. The outcome of the analysis of the items in Section B is presented in Table 1.

Table 1: Teachers’ Knowledge Level

No.	Statement	STS (1)	TS (2)	TP (3)	S (4)	SS (5)	Mean	SD	Level
1	Understand basic concepts of current, voltage, resistance	0	24	4	92	40	3.93	0.94	High
2	Apply Ohm’s Law in circuit calculations	4	24	4	96	32	3.8	1.02	High
3	Explain functions of components (resistor, capacitor)	0	20	12	84	44	3.95	0.93	High
4	Understand series & parallel circuits	4	24	8	88	36	3.8	1.04	High
5	Read measuring tools (multimeter)	0	8	24	88	40	4.0	0.78	High
6	Understand transistor concept	0	24	8	96	32	3.85	0.92	High
7	Explain energy conversion principles	0	28	20	80	32	3.73	0.99	High

Overall Mean = 3.86 | SD = 0.95 | Level = High

Table 1 indicates the level of knowledge of the teachers on technical skills of Design and Technology, Electrical and Electronics subtopic, consists of frequency, percentage, mean score, and standard deviation. The general mean of the level of knowledge of the teachers is 3.86, which shows that the level of knowledge of the respondents is high.

This is also validated by the results that indicated that 60 percent of the sampled respondents are aware of how to use the ohm law, and the general concept of transistors in electronic circuits.

Dissection of Section C: Level in Design and Technology Electrical and Electronics Subtopic of the Teachers Technical Skills.

Results of the analysis of the items of Section C are represented in Table 2.

Table 2: Teachers’ Technical Skills

No.	Statement	STS (1)	TS (2)	TP (3)	S (4)	SS (5)	Mean	SD	Level
1	Assemble series & parallel circuits	0	20	4	88	48	4.03	0.92	High
2	Use multimeter effectively	0	20	12	80	48	3.98	0.95	High
3	Install components correctly	0	16	20	72	52	4.0	0.93	High
4	Arrange circuits per specification	0	20	16	84	40	3.9	0.93	High
	Solve basic circuit problems	0	24	28	68	40	3.78	0.99	High
6	Operate oscilloscope	4	24	12	88	32	3.75	1.03	High
7	Troubleshoot circuits	8	20	20	80	32	3.68	1.09	Moderate

Overall Mean = 3.87 | SD = 0.99 | Level = High

Table 2 shows the frequency distribution, percentages, mean scores and the standard deviation of level of technical skills of the teachers in Design and Technology in Electrical and Electronics subtopic. The mean of the total score is 3.87 which shows that the technical level of skill of the teachers is high.

It has six items of high level and one item of moderate level. The top one is the Item 1, which allows the respondents to complete simple series and parallel circuits correctly, their percentage is 55.0, and mean score equals 4.03.

Nevertheless, the best mean score was 3.68 in Item 7 and this falls below the moderate category, which means that there are still a number of respondents who have difficulty in doing testing and troubleshooting errors at the electronic circuits.

Discussion of Section D: Constraint on Design Teachers and Technology teachers in the Electrical and Electronics Subtopic. The table 3 illustrates the analysis of the items in Section D.

Table 3: Teachers’ Constraints

No.	Statement	STS (1)	TS (2)	TP (3)	S (4)	SS (5)	Mean	SD	Level
1	Lack of reference materials	0	0	0	48	112	4.7	0.46	High
2	Difficulty accessing equipment	0	0	4	24	132	4.8	0.46	High
3	Lack of time for practical work	0	0	0	12	148	4.93	0.27	High
4	Need more training	0	0	0	20	140	4.88	0.33	High
5	Difficulty understanding complex concepts	0	0	4	32	124	4.75	0.49	High
6	Need admin support	0	0	0	12	148	4.93	0.27	High
7	Difficulty explaining concepts simply	0	0	2	24	128	4.75	0.54	High

Overall Mean = 4.82 | SD = 0.40 | Level = High

Table 3 shows the frequency, percentage, mean score and standard variation of the constraints encountered by Design and Technology teachers in Electrical and Electronics subtopic. The average score is 4.82 which means the constraints of the level are high. The top ones are the Item 3 and 6 that states; not enough time to perform practical activities and should have more school administration support. Both listed the percentage at 92.5% and mean score of 4.93, which is classified as high.

DISCUSSION

According to the study analysis, the knowledge level of teachers in technical skills of Design and Technology in Electrical and Electronics subtopic is at the high level. This observation shows that the teachers have a deep grasp of the basics, including electrical laws (Ohms Law and Kirchoff’s Law), circuit design and the workings of electronic elements, including capacitors, diodes and transistors. The knowledge will help the teachers to have a good foundation to deliver instructions in a better manner, and to be able to explain the concepts to the students. The reason why the teachers possess high level of knowledge can be explained by the active participation of teachers in training courses and technical workshops that are organized either by schools or external agencies. This observation is also supported in a study conducted by Mohamad et al. (2020), which showed that teachers who regularly participated in an ongoing professional development process showed competency levels in technical subjects.

Moreover, the assistance of the school administration in the provision of sufficient learning materials, e.g., simulation material and updated reference materials, also plays the role in improving the knowledge of teachers.

According to the analysis of the study, the level of technical skills of teachers in Design and Technology in relation to Electrical and Electronics subtopic is also high. This shows that teachers are skills in working on technical procedures like connecting electrical circuits, and testing tools like multimeter and oscilloscopes, and with electronic parts like diodes, transistors and capacitors. The teachers can also apply practical teaching methods and help students in their practical practices and effectively solve Electrical and Electronics related issues. Besides, the results reveal that the degree of restrained experienced by Design and Technology teachers in the Electrical and Electronics subtopic is also high. In spite of the fact that teachers exhibit great technical skills, they still have various challenges that prevent them to adopt effective teaching implementation. The primary limitations that are pinpointed are inadequate laboratory facilities, lack of time to prepare quality teaching resources, and the inability to receive constant professional development. Teachers are in most instances compelled to fit the learning materials at their disposal to suit educational requirements although they do not have the resources to facilitate optimal teaching behaviours.

CONCLUSION

In general, this research works has been very informative on the technical competence of Design and Technology educators on the Electrical and Electronics subtopic. The three factors mentioned here knowledge, technical skills and constraints are those crucial points that are to be stressed out by the teachers in the schools. The performance and effectiveness of teachers ought to be in accordance with their duties of teaching technical skills.

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