Teacher Readiness in Terms of the Teacher Attitudes Towards Teaching Secondary School Quantum Physics in Sabah

Stephanie Sungkim and Mohd Zaki Ishak

***Abstract* – Modern technology is essentially dependent on quantum physics in today's world, and the rapid growth of technology necessitates the inclusion of Quantum Physics (QP) into a variety of fields, including industry and daily life. As a result, the inclusion of QP in the school curriculum in 2021 is expected to keep pace with the rapid advancement of technology, which will begin with the youngest kids. As a result, this study sought to ascertain the level of teacher preparedness for teaching secondary school QP in Sabah. This quantitative study used a survey design and a sample size of 175 Form Five Physics teachers in Sabah who were chosen through a multistage cluster sampling procedure. The research tool was a questionnaire that had been adapted and modified. The instrument's reliability was high, at .87. The study's data were analysed using IBM SPSS version 28.0 software. The study's findings indicate that teacher readiness is high in terms of teacher attitudes (m=7.91). The outcomes of this study can help policymakers and the Malaysian Ministry of Education gain a better understanding of the current status of Physics teachers' perceptions toward QP implementation once it has been implemented in 2021. The study's results also indicate that teacher attitudes toward teacher readiness are critical for maintaining the quality of secondary school QP teaching.**

***Keywords* – Attitudes, Physics teacher, Teacher readiness, Secondary school, Quantum Physics**

I. INTRODUCTION

Malaysian education is being revamp to compete globally, resulting in a 2018 Physics curriculum revision. The Integrated Secondary School Curriculum (*KBSM*) was originally established in 1989 and transformed to the Secondary School Standard Curriculum (*KSSM*) in 2010. Like other STEM elective topics in KSSM, form 5 physics has Quantum Physics (QP) added. Secondary school physics aims to teach students science and technology (Bahagian Pembangunan Kurikulum, 2018a). Based on this purpose, the Secondary School Physics Standard Curriculum adds QP at the end of the syllabus. Modern technology is dependent on QP (Calýskan et al., 2009), and its rapid rise incorporates QP applications in business and daily life, such as lasers, transistors, tunnel microscopes, and mobile phones (Fritzsch, 2008). Implementing QP in schools is regarded to be in accordance with young students' rapid technological progress.

Quantum Physics (QP) is different from classical physics, yet an understanding of wave and optical physics is needed to understand QP (Zollman, 1999). Wave functions, uncertainty principles, and superposition principles in QP can't be explained using classical physics notions (Ladj et al., 2010). At the secondary school level, misconceptions between classical physics and QP have been debated among scholars due to its difficulty in understanding and describing the processes and phenomena of particle interference concepts (Berman, 2018; Krijtenburg-Lewrissa, 2020). This affects teachers' ability to teach the topic and students' ability to understand concepts such as photon wave-particle duality and absorb the reality of QP (Bungum et al., 2015). QP may be taught in secondary schools, as Johansson and Milstead (2008) (2008) illustrate. They employ the *gedanken* (thinking) experimental technique to assist students grasp QP. According to Bungum et al. (2015), most teachers agree that a historical approach to promoting students' conceptual grasp of QP through pictures can be helpful. The government has created a Curriculum and Assessment Standards Document (*DSKP*) including content standards, learning standards, and performance standards for teachers to reference and review so they may plan teaching and learning activities, whether they know QP or not in-class and QP assessment (Bahagian Pembangunan Kurikulum, 2018b). The Ministry of Education has made all attempts, but teachers are still unsure and insufficient to teach QP. The school does not support teachers teaching QP in a short time.

Response to QP topics depends on teachers' readiness to teach new topics to Form 5 students (Barros & Elia, 1998; Huoy Tyan et al., 2020). Teachers feel happy and willing to teach when they can teach without textbooks (van Aalderen-Smeets & van der Molen, 2013). When teachers grasp the relevance of QP topic knowledge, they will equip themselves to attract students to acquire it (Foppoli et al., 2018). A study by Ramanan and Mohamad (2020) indicated that change readiness affects whether teachers are ready for change and furthers theory and research on the topic. The readiness of teachers to accept new curriculum changes is crucial to the success of educational transformation. Teachers' concerns would make school reform more successful, they said. Teachers must be willing to modify their attitude to succeed in transforming education.

II. PROBLEM STATEMENT

The rapid growth of modern technology has unquestionably had a significant impact on human life, and the rapidity of QP today is even more quick. Consequently, QP was incorporated into secondary school curricula in a number of nations prior to Malaysia. Based on the new curriculum, QP will be taught to secondary school students in Malaysia in 2021. Due to this newly revamp curriculum, teacher training has not yet been implemented in its whole. This issue is frequently disregarded in the development and execution of new programmes, despite the fact that the Ministry of Education faces significant obstacles in educating teachers to accept educational transformation

Stephanie Sungkim, Universiti Malaysia Sabah, Malaysia (Email address: stephaniesungkim@gmail.com).
Assoc. Prof. Dr. Mohd Zaki Ishak, Universiti Malaysia Sabah, Malaysia (Email address: movolk@ums.edu.my).

(Ramanan & Mohamad, 2020). According to research on teacher readiness, one of the important components of teacher readiness is attitude (Park et al., 2016). A study by Fan et al. (2019) demonstrates that attitudes is one of the component of teacher readiness.

Teacher attitudes can determine whether or not they are ready to teach a new subject (Richardson, 1996). This is confirmed by prior research indicating that attitudes positively influence a person's willingness to accept change, where positive attitudes indicate full support for the change occurring and vice versa (Kondakci et al., 2017; Richardson, 1996; Wan Mahmood et al., 2016). Positive attitudes of teachers have a positive impact on student performance and a significant impact on their performance (González-Gómez et al., 2019; Ulug et al., 2011) therefore, it is crucial for teachers to be positive with this curriculum transformation in physics education so that students can easily grasp the conceptual understanding of QP. Since it is well known that QP is a hard topic to be comprehend due to its abstract conceptual (Russo & Persano Adorno, 2018). Teachers should be optimistic about the things they wish to implement to assist pupils comprehend them, and they should provide positive feedback on the topics they have studied (Layang & Mahamod, 2019). The new revised curriculum shows, based on the arguments and issues highlighted, that it is necessary to measure the level of teacher readiness and the extent to which teachers' attitudes influence their readiness to teach QP. To ensure that teachers' needs are satisfied in order to improve student performance.

Consequently, this study will incorporate Theory of Reasoned Action and Weiner's theory of individual change to assess teachers' attitude-based readiness to teach QP. Theory of Reasoned Action emphasises the relationship between attitudes and actions in human behaviour, where curriculum adjustments will alter teacher attitudes.

III. LITERATURE REVIEW

Teachers Readiness Related to Teachers Attitudes

Generally, it is the responsibility of teachers in today's classrooms to establish teaching methods that are optimal for their students. The teacher must be ready in the classroom in order to impart the curriculum's material effectively. Studies demonstrate a correlation between teachers' attitudes and their preparedness (Mohd Shahali et al., 2015). Hill et al. (1977) define attitude as an individual's favourable or unfavourable view of something or someone. Attitudes are the feelings a person has towards anything depending on his or her knowledge and beliefs about that subject (Holt et al., 2007; Nilsson & van Driel, 2011; Yari et al., 2019). In this context, a teacher's attitudes towards teaching QP refers to the teacher's preparation, expectations, and efforts towards teaching QP within the school system.

Teachers' attitudes are vital for understanding instructional procedures, classroom practises, adopting modifications, and learning how to teach (Richardson, 1996). When teachers are enthused about their topic, infuse their science lessons with inspiration, and contextualise it in everyday life, this will result in good teaching (Osborne et al., 2003). Consequently, students will have a solid understanding of the topic being taught. The teachers' attitudes will determine how they perceive the introduction of new curriculum topics (Vossen et al., 2019). Students' attitudes on the new topic will be influenced by the teachers' attitudes. According to a study by Sargioti and Emvalotis (2020), pupils with a good attitude can be identified by the growing number of students who participate actively in class activities, leading to a greater comprehension of the contents presented.

In addition, a study by Mousa (2016) demonstrates that teacher attitudes are a significant variable associated with teacher readiness to teach. This study demonstrates that teachers with a positive outlook are more likely to be hard-working and open to receiving training for their development. This is confirmed by the findings of Ungar (2016), who discovered that teachers with positive attitudes are prepared to do more preparation for the teaching process, even if it is their first time using metaphor approaches in the classroom. The teachers in the study believe they will eventually improve their metaphor-based teaching methods by voluntarily learning from expert educators. In addition, teachers with good attitudes are more committed to teaching the new topic than teachers with less positive attitudes, where teachers were eager and unrelenting in their teaching (Santiago, 2019).

Previous research has demonstrated that teachers with low content understanding have negative attitudes (Mousa, 2016; Vossen et al., 2019). Negative teacher attitudes toward science have led to bad classroom practise (Mousa, 2016). Teachers believe this promotes a good attitude toward the subject. Vossen et al. (2019) discovered that teachers with negative attitudes, such as lack of interest, can pass these on to their students. Students learn best while receiving positive teacher comments and having fun. Students despise a topic when they receive unfavourable feedback and have no fun learning. Positive-attitude teachers teach creatively because they are confident and like teaching (Riegle-Crumb et al., 2015). Creative teachers create hands-on activities and student-centred learning before entering the classroom (Shidiq & Yamtinah, 2019). They will educate the topic and relate daily occurrences. This method may satisfy students' curiosity about QP topics.

Teachers Readiness of Teaching Quantum Physics in Secondary Schools

When it comes to the processes of teaching and learning, teacher readiness is one of the most critical components, particularly when a new subject or new curriculum is being introduced. It is possible to define "teacher ready" as the stage of planning in which teachers have a favourable attitude toward the transition and a willingness to take action in the future for the benefit of their students (Holt & Vardaman, 2013). The readiness of a teacher can also be characterised as the teacher's willingness to take on duties that involve aspects such as their interests, attitudes, knowledge, and abilities (Wearmouth et al., 2000). As for the setting of this study, it is in the context of a new subject called QP that is being included in the curriculum for physics.

According to Ungar (2016), attitudes are one of the

factors that determine the readiness of teachers. According to the results of their research, teachers who have a favourable disposition toward educational reform and a high level of readiness go hand in hand with one another. This finding is confirmed by the research conducted by Mohd Yusof and Ibrahim (2012), who discovered that instructors in the study showed favourable attitudes towards preparation when they were able to comprehend the needs of the curriculum. This finding was found to be supported by the research. After gaining such an in-depth comprehension of the requirements of the curriculum, they were able to impart their knowledge to the pupils in an efficient manner.

However, the findings of the study are inconclusive, which leads many academics to claim that there are more factors that determine teacher preparedness. Some of these characteristics include prior teaching experience, pedagogical content knowledge, and support from administrators. The vast majority of research demonstrate that a teacher's attitudes play a significant role in determining the level of teacher readiness (Baharudin & Ibrahim, 2020; Mohamed Hata & Mahmud, 2020).

Without a doubt, the readiness of the teachers will be the deciding factor in whether or not the new curriculum is successful. It is also parallel to the demands of the national education system because the curriculum in modern times is always changing in order to stay up with the progress of education all over the world.

IV. METHOD

In a quantitative research design, a survey 31-item questionnaire was used to describe the influence of teacher readiness on the level of teacher readiness to teach secondary schools QP. The current study's population consisted of Form Five Physics teachers in Sabah for the purposes of this study. The teachers involved are from 24 districts spread across six zones in Sabah. Because of Sabah's large geographical area, this study used multistage cluster sampling followed by simple random sampling. Following data cleaning, 175 responses from physics teachers were deemed eligible for data analysis. After permission from the authors was granted for adaptation and adoption, the survey questions were adjusted to match the study objective. It also includes three sections: demographic data, teacher attitudes, and teacher readiness. The Rasch Measurement Model analysis yielded a Cronbach (Cronbach) alpha coefficient (KR-20) of .87, indicating that the instrument is reliable. Since this value is so high, the reliability of the questionnaire can be used as a tools in collecting data (Sumintono & Widhiarso, 2015).

Google Forms was used to create a web-based questionnaire. Since an online survey can be easily disseminated across multiple social media platforms, it would allow a larger number of people to participate in the study. After obtaining permission to collect data, the questionnaires were distributed to 180 Sabah physics teachers via a Google Form link. Teachers who volunteered to participate in this study were asked to answer all questions thoroughly and honestly based on their own experiences and thoughts about the use of QP in secondary school curriculum. After a month, 178 people completed the survey and submitted their responses. After data cleaning and outliers were considered, 175 questionnaires were collected and analysed for this study.

For descriptive statistics, the collected data were analysed using SPSS Version 28 software. Frequencies and percentages were used to gather information about the respondents' backgrounds, as well as their attitudes and readiness to teach secondary schools QP.

V. FINDINGS

The survey instruments were intended to study the Physics teachers' level of content knowledge of QP and their level of readiness of teaching secondary schools QP. The total mean score for each section based on constructs is tabulated in Table 1. Based on Table 1, majority of the respondents were high in their attitudes (M = 7.91, SD = 1.13) in regards to teach QP topics. On the other hand, the finding also shows that majority of the respondents possesses medium high of readiness (M = 6.96, SD = 0.74) on the QP implementation in secondary school physics curriculum. Data presented on Table 2 shows that majority of the respondents admitted that they do not have adequate information about the topic of QP and cannot teach the topic of QP in a favourable situation.

TABLE 1: TOTAL MEAN SCORE ON SECTION BASED ON THIS SURVEY

Section	Mean	SD
Teachers Attitudes	7.91	1.13

TABLE 2: LOWEST MEAN SCORE FOR TEACHERS ATTITUDES

Section	Mean	SD
I have adequate information about the topic of quantum physics.	5.46	2.19
I can teach the topic of quantum physics in a favourable situation.	6.95	1.95

VI. DISCUSSION

Teachers Attitudes Towards Teaching Secondary Schools Quantum Physics

The findings of this research indicate that teachers have a high level of attitudes on their readiness to teach secondary schools QP. This illustrates that many teachers, despite the fact that QP in the Physics curriculum is still relatively new, continue to have a desire to teach this fresh subject matter. Since there is still a lack of training for teachers relevant to the subject of QP, the item with the lowest means shows that teachers do not have appropriate understanding about the subject of QP.

In spite of the fact that QP is an abstract subject, the majority of teachers, according to the findings of this survey, believe that it is essential for them to complete some form of self-study before delivering on the subject. In order to ensure that teachers have more positive attitudes when teaching curriculum related to QP topics, it is imperative that teachers obtain adequate training so that they can be better prepared to anticipate and respond to any issues (Mohamed Hata & Mahmud, 2020; Park et al., 2016).

Teachers' Readiness of Teaching Quantum Physics in Secondary Schools

Due to the fact that QP is a completely new topic that has been added to the physics curriculum, the readiness of teachers to teach it in secondary schools is reliant on the maturity and experience of the teachers (Du & Chaaban, 2020; Kondakci et al., 2015). The readiness of a teacher to teach a certain subject can also be characterised as the teacher's desire to accept on duties that encompass aspects such as the topic's interests, attitudes, knowledge, and skills (Wearmouth et al., 2000).

According to the findings of this research, there are two aspects of teacher readiness that have the mean score that is the lowest possible. The two items were connected to the process of developing a standard set of questions applicable to all levels of student accomplishment in the context of QP education received in the classroom. While the other aspect pertains to providing students with a more tangible understanding of abstract QP events through the use of whiteboard drawings, the former is utilised during the process of studying and teaching the subject.

The abstract QP cannot be clearly explained to students solely through drawings alone; rather, explanations need to use simulations to help students better understand (Kalkanis et al., 2003; Kohnle et al., 2010; Müller & Wiesner, 2002). Drawings alone are insufficient to convey the information (Kalkanis et al., 2003; Kohnle et al., 2010). As a result, teachers have a greater responsibility to improve their level of readiness in terms of proactive teaching strategies.

VII. CONCLUSION (OR LIMITATION OR SUGGESTION FOR FURTHER STUDIES)

This study will determine the level of attitudes and readiness of physics teachers to apply QP in secondary school physics curricula. The purpose of this study is to determine the level of attitudes and readiness of physics teachers. It is possible that the outcomes of this study will offer educational stakeholders with an up-to-date image of the attitudes and readiness of physics teachers for the implementation of QP. According to the findings of this study, it is recommended that teachers of physics take effective preventive actions in order to keep their level of attitudes regarding the newly introduced topic in Physics *KSSM*. This is because the level of such attitudes may have a significant impact on the teachers' readiness to incorporate the QP into the physics curriculum. This study has implications for future research in that it can be applied to broader aspects of the secondary school curriculum that is currently being taught in Malaysia. For example, the research might be conducted with a larger sample size to increase the likelihood that the findings will be applicable to a larger population and to facilitate their generalisation to a wider range of people. In conclusion, it is recommended that this study be repeated using a mixed-methods approach in order to provide researchers with the opportunity to acquire a more in-depth understanding of the level of attitudes held by physics teachers and their readiness for newly added topics in secondary school physics curricula.

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