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The Rasch Model Analysis of Secondary School Teachers' Acceptance of STEM Implementation in Teaching and Learning in Labuan

Mohammad Azri Bin Amatan*, Crispina Gregory K. Han, Vincent Pang

[a]*Faculty of Human Sciences, Universiti Pendidikan Sultan Idris, Jalan Universiti, 35900 Tanjong Malim, Perak, Malaysia*
[b]*Faculty of Education and Sport Studies, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia*

Abstract

This study aims to assess the acceptance of the implementation of STEM approaches in teaching and learning by secondary school teachers in the Federal Territory of Labuan. This study uses a quantitative assessment approach of a sample survey type. Data were collected through the STEM Implementation Acceptance Questionnaire involving 314 teachers who were randomly selected from nine secondary schools. Rasch model data analysis using WINSTEPS Version 3.69.1 software was applied to produce a Wright Map to measure the acceptance aspects of STEM implementation through the study questionnaire items. The results of the study showed that items that were difficult to accept included making quantitative predictions (measure > 1 logit), reducing exam stress, and developing a problem-solving model, while items that were easy to accept were fostering positive values, early planning, and various teaching and learning methods (measure < -1 logit). The component of teacher belief in STEM recorded the highest mean measure value (0.43 logit), followed by attitude (-0.30 logit) and teacher commitment (-0.11 logit). Teachers were more likely to accept the aspects of attitude and commitment than belief in the importance of STEM. The findings of this study provide an overview of the strengths and weaknesses of teachers' acceptance of STEM implementation in teaching and learning, which should be taken into account to increase teachers' confidence, attitude, and commitment towards the implementation of STEM in secondary schools.

Keywords: STEM Acceptance Assessment, Teaching and Learning, Rasch Model

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1. Introduction

A survey finds Malaysians' acceptance of STEM fields still at a low level (KPM, 2013; OECD, 2012, 2019; Yusof et al., 2012). The latest data shows that there has been only a slight increase in the number of students choosing STEM streams, which is 50.83% in the intake of STEM students in 2024. This data shows that there is still a lack of acceptance in venturing into STEM fields compared to developed countries that are more intensive in implementing STEM in their education systems (Malaysia, 2024). This situation is in stark contrast to the scenario in developed countries, where, in the United States, for example, there has been a significant increase in the tendency to choose STEM fields. According to data from the National Science Foundation in 2019, more than 50% of secondary school students chose STEM streams, indicating a high interest in these fields. In the Malaysian context, the question arises as to what is the actual level of STEM implementation that has been implemented by teachers in secondary schools. The National STEM Movement raised the weaknesses in the implementation of STEM that exist in Malaysia in the context of secondary schools, touching on the issue of acceptance among teachers that should be taken seriously. It was found that teachers face issues in implementation when the mastery of contextual aspects, such as the lack of sufficient information and knowledge in the field of STEM knowledge, makes it difficult for them to be creative for the benefit of attracting students' interest. As a result, there are weaknesses in the implementation of integrating STEM education elements in teaching and learning that are not satisfactory, in addition to the claim that teachers do not receive good cooperation due to the effects of school management bureaucracy (Harian, 2019).

* Corresponding author.
E-mail address: azri.amatan@fsk.upsi.edu.my

The National STEM Movement also revealed that the failure to appreciate the implementation of STEM-orientated teaching and learning is not only due to the aspects of teachers and students but is also contributed to by the weaknesses of school management, who are seen as less confident in the ability of teachers and students to apply STEM knowledge in schools. This phenomenon has contributed to the downward trend in the number of science classes in schools, which previously had four or five (Harian, 2019). For this reason, the National STEM Movement emphasises that the issue of low acceptance of STEM implementation requires further clarification and should be addressed because its effects have a negative impact on the country's ability to compete in facing future challenges. Through these statistics, it is clear that there is a lack of STEM implementation in the education system, thus creating a gap in acceptance among Malaysians, especially among secondary school students who are identified as still at a weak level (Noraini, 2019). If the STEM acceptance gap in education is not addressed, it will only widen and have a very negative impact on the country's development competitiveness. The impact will be that the country will continue to be trapped and left behind in the changing tide of a borderless world.

In the context of teaching and learning in secondary schools, the reality of implementing STEM through the role of teachers is still not maximised (Amimah, 2018). It has been identified that the momentum of teacher acceptance in implementing STEM-related policies and curricula is still slow. This situation also occurs in the context of secondary schools in the Federal Territory of Labuan. It was found that teachers still have not accepted its implementation well in the national education system (Noraini, 2019), so much so that the effect causes implementation problems in empowering teachers' roles as expected, especially in carrying out the duties and responsibilities of teaching and learning that have been standardised in the guidance document. The evidence is that teachers are still weak in the strategy of applying STEM education in teaching and learning (KPM, 2016). Teachers are still not as sensitive and do not play the role they should in delivering information and promoting the potential of STEM in education (Malaysia, 2018; Noraini, 2019). In addition, Amimah, 2018 explains the weak role of teachers in this aspect, causing the integration of STEM education elements in teaching and learning to still not be maximum. It was also found that school institutions, through the role of teachers, are still insufficient and less effective, especially in promoting the potential of STEM-related career fields in education.

Meanwhile, efforts to attract interest and awareness with the goal of increasing acceptance should have been completed in the first wave (2013-2015) and the second wave (2016-2020). Unfortunately, even after entering the third wave phase (2021-2025), overall the problem of acceptance of STEM is still a problem and has not been addressed (Malaysia, 2018). Similarly, with the intention of introducing the STEM Implementation Guide in the teaching and learning document, the MOE hopes that the guide will be well received by teachers to be used as a guideline in teaching and learning in secondary schools. However, it was found that the use of the guide has not yet been fully utilised and has failed to be translated properly. Therefore, a study needs to be conducted with the objective of assessing the actual level of teacher acceptance in the implementation of STEM in secondary schools so that corrective efforts from the perspective of teachers as implementers can be taken into account. Furthermore, the latest scenario of STEM implementation in Malaysia since it was introduced as a cross-curriculum element and further intensified through the PPPM 2013-2025 is that it is time for an evaluation study to be conducted to assess the acceptance aspect of its implementation from the perspective of teachers as implementers to ensure that it is on the right track as outlined by the MOE through the STEM Implementation Guide. Through the findings of this study, it helps to identify the level of STEM acceptance from the perspective of teachers as implementers. Information like this is important as feedback to all parties involved in strengthening the implementation of STEM in teaching and learning in planning to improve the effectiveness of the implementation of STEM itself.

At the same time, research on the implementation and teacher evaluation in STEM education has expanded significantly since 2020, especially in countries that are more aggressive in integrating STEM across their education systems. In Malaysia, studies by Rahman, 2020 and Ramli, 2020 have developed and validated instruments to assess preschool and secondary teachers’ STEM readiness using the Rasch Model, while Qudratuddarsi, 2022 focused on STEM application by Gen-Z teachers during the pandemic. Similar research has been conducted internationally. Tagupa & Arnado (2024) applied Rasch analysis to evaluate pre-service teacher competencies in the Philippines, while Fitrah & al. (2024) assessed culturally contextualised math items in Indonesia. In Europe, Turgut et al. (2024) developed instruments to assess mathematics teachers’ pedagogical technology knowledge, emphasising computational thinking and programming tools. Regarding teacher acceptance and concern over STEM implementation, Lau & Jong (2023) in Hong Kong applied a typology based on change theory, while Zhou et al. (2022) in China explored factors influencing STEM teaching acceptance. Susilo & Sudrajat (2020) highlighted barriers such as lack of resources and training among biology teachers in Indonesia. From the student perspective, readiness and attitude studies such as Ringo (2021), Guo et al. (2022), and Wang et al. (2024) reveal urban-rural divides and multilevel influences on science attitudes. Meanwhile, Chiriacescu (2023) examined teacher competencies using multigroup models.

To move beyond sole reliance on the Stufflebeam model, recent studies have applied alternative theories like the Technology Acceptance Model (TAM) by Davis (1989) and the Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh et al. (2003). These models assess behavioral intention and user acceptance of technology in teaching. For instance, Mohamed & Ahmad (2023) evaluated teachers' readiness for Education 4.0 technologies in the UAE using UTAUT, while Nofitriyani et al. (2022) assessed secondary-school students' acceptance of online learning systems in Indonesia using the UTAUT model. UTAUT and its extensions have also been used to explore e-learning adoption across Oman (Almaki et al., 2024), China (Chen et al., 2023), and Indonesia (Tussardi et al., 2021). Outada et al. (2023) even compared TAM and UTAUT models in post-COVID-19 e-learning contexts (Akbar et al., 2024). These studies show that how teachers are evaluated and how STEM is being used are changing with different approaches and modern theories, highlighting that Malaysia should look at how other ASEAN, East Asian, and European countries do things to create a better and more informed STEM education policy.

2. Methodology

This study applied an evaluation research approach based on the Stufflebeam (1986) evaluation model, which used a quantitative research approach using a sample survey. A total of 314 teachers from nine secondary schools in the Federal Territory of Labuan were selected as the study sample using a stratified proportional random sampling technique. For the purpose of data collection, the STEM Implementation Acceptance Questionnaire (IAQ-STEM) instrument that had been developed was fully used for the data collection process. This questionnaire used a five-point Likert-type scale. WINSTEPS Version 3.69.1 software was also applied to generate the study data.

2.1. Development and Validation of the Questionnaire

The development of the STEM Implementation Acceptance Questionnaire (IAQ-STEM) was guided by the three-stage model of instrument development proposed by Walker & Fraser (2005) who outlined a systematic process comprising three phases: first, identifying constructs through literature review, analysis of previous instruments, and expert consultation; second, constructing and validating items via adaptation, expert review, and validity and reliability testing using CVR, CVI, Rasch, and Exploratory Factor Analysis (EFA); and third, conducting the actual study with a larger sample and testing construct validity to ensure the instrument is valid and applicable. In line with this approach, the IAQ-STEM was developed based on the Theory of Reasoned Action by Fishbein & Ajzen (1975), incorporating three core constructs: teacher belief, attitude, and commitment. Operationally, belief refers to teachers' confidence in the importance of implementing STEM in teaching and learning; attitude encompasses positive tendencies such as interest, motivation, and confidence; and commitment reflects teachers' dedication to systematic and effective STEM implementation. Item development involved literature review, adaptation of existing instruments, and expert input, as detailed in Table 1 and Table 3. The validation process included expert reviews (Table 3), calculation of the Content Validity Index (CVI), and a pilot study that confirmed normal data distribution (skewness = -0.297; kurtosis = 0.871), high reliability (Cronbach's Alpha = 0.974), and strong construct validity (KMO = 0.971; Bartlett's Test, $p < 0.01$). After eight rounds of item refinement, the final instrument comprised 31 items representing three main factors, explaining 68.6% of the total variance.

Table 1. Outlines references supporting each IAQ-STEM component.

Components	References
Teachers' Beliefs About the Importance of STEM Practices	Fishbein & Ajzen (1975), Ajzen (1991, 2006), Hall & Hord (2001), Shepard (2000), Law (2008), Tan (2010), Shumow & Miller (2001), Pryor et al. (2015), Copriady (2014), Chiu et al. (2015), Suresh Kumar (2011), Han, (2015), Tschannen-Moran (2003), Misha (1996), Strike (2007), Syed Mustafa (2013), Thorndike (1997), Coleman (1990), Ernest (1989), Constant et al. (1994), (Dennis 1996), Thompson (1992), Guskey (2002), Kulkarni et al. (2006), Adnan & Zakaria, (2019), Fives & Buehl (2014), Kagan (1992), Bekiroglu-Ogan (2009), Alkharusi (2009), Kurikulum (2016), Idris (2016), Mohd Tahir & Rahman (2007), Ajzen & Fishbein (2000), Reio (2005), Zaaim et al. (2019), Hurlock (1978), Halili & Suguneswary (2016), Frey & Fisher (2004), Demetriadis (2003) & Ghani (2007)

Components	References
Teachers' Attitudes Towards STEM Implementation	Fishbein & Ajzen (1975), Stufflebeam (1987, 2001), Rummers & Gage (2016), Zimbardo & Leippe (1991), Yusof et al. (2012), Amatan & Han (2019), Mat Loddin & Abdul Kadir (2013), Stenhouse (1984), Stiggins, (2005), Idris (2016), Shepard (2000) & Ghani (2007)
Teacher Commitment in STEM Implementation	Fishbein & Ajzen (1975), Shepard (2000), Hall & Hord (2001), Law (2008), Tan (2010), Miller et al. (2009), Yassin et al. (2017), Stenhouse (1975), Olson (2000), Rudduck et al. (1995), Blenkin et al. (1992), Fullan (2001), Arbaa et al. (2010) & Louis (1998)

Table 1 illustrates that the “Teacher's Belief” component draws from the widest range of references, combining foundational theories, policy documents, and empirical studies. Meanwhile, “Teacher's Attitude” and “Teacher's Commitment” are each supported by a focused set of literature, emphasising educational psychology, professional behaviour, and policy alignment validating their theoretical and contextual grounding in STEM implementation.

Table 2. Determination of the Components of the STEM Implementation Acceptance Questionnaire (IAQ-STEM).

Components	Item No.	*Adopt* (√)	*Adapt* (√)	*New* (√)	References
Teachers' Beliefs About the Importance of STEM Practices	D8			√	Kurikulum (2016)
	D9			√	Kurikulum (2016)
	D7			√	Kurikulum (2016)
	D12			√	Kurikulum (2016)
	D3		√		Kurikulum (2016)
	D10			√	Kurikulum (2016)
	D5			√	Kurikulum (2016)
	D6			√	Kurikulum (2016)
	D4			√	Kurikulum (2016)
	D2			√	Idris (2016)
Teachers' Attitudes Towards STEM Implementation	D16		√		Idris (2016)
	D15		√		Idris (2016)
	D18		√		Idris (2016)
	D21		√		Idris (2016)
	D14		√		Idris (2016)
	D22		√		Idris (2016)
	D19		√		Idris (2016)
	D20		√		Idris (2016)
	D17		√		Idris (2016)
	D23		√		Idris (2016)
	D24		√		Idris (2016)
Teacher Commitment in STEM Implementation	D32		√		Idris (2016)
	D34		√		Idris (2016)
	D33		√		Idris (2016)
	D35		√		Idris (2016)
	D31		√		Idris (2016)
	D29		√		Idris (2016)
	D30		√		Idris (2016)
	D28		√		Idris (2016)
	D25		√		Idris (2016)
	D26		√		Idris (2016)

Table 2 shows the item sources for the IAQ-STEM questionnaire, consisting of 31 items covering three components: belief (10 items), attitude (11 items), and commitment (10 items). All items are sourced from adaptations by Idris (2016)and the STEM Implementation Guide (Kurikulum, 2016)

Table 3 lists 13 expert panel members involved in validating the questionnaire. The panel includes specialists in STEM education, science, mathematics, technical education, and statistical measurement, with experience ranging from 10 to 38 years across educational institutions and national agencies.

Table 3. List of Expert Review Panel.

Expert	Field of Expertise	Institution / Position	Experience
Expert 1	STEM education	National STEM Movement	30 Years
Expert 2	Science Studies	Science School	32 Years
Expert 3	Science Education	Faculty of Educational Psychology	30 Years
Expert 4	STEM education	Faculty of Educational Psychology	30 Years
Expert 5	STEM education	STEM Foundation Center	30 Years
Expert 6	Mathematics & Science Education	Department of Mathematical Sciences	10 Years
Expert 7	Science & Technical Education	Department of Technical Sciences	21 Years
Expert 8	STEM education	Senior STEM Teacher	10 Years
Expert 9	STEM education	Senior STEM Teacher	12 Years
Expert 10	STEM Model Development	Faculty of Education	12 Years
Expert 11	Statistics & Surveys	Malaysian Institute of Environment	19 Years
Expert 12	Statistics, Evaluation Measurement	Faculty of Education	38 Years
Expert 13	Statistics, Evaluation Measurement	Faculty of Education	29 Years

2.2. Item Analysis (Wright Map) - Individual-Item Distribution Map

Teacher feedback on the implementation of STEM in teaching and learning in secondary schools in the Federal Territory of Labuan was analysed by utilising the advantages of Wright Map. The Rasch Measurement Model produces a Wright Map, also known as an item map or individual-item mapping, and is able to display the distribution of items on an instrument relative to individual abilities along a logit scale of a measurement continuum, starting from the easiest level to the most visually difficult level. The Wright Map display shows the position of individuals on the left side, while the position of items is on the right side. The top part of the scale indicates individuals with high abilities and the most difficult items, whereas individuals with low abilities and the easiest items are located at the bottom of the scale and separated by a dashed line (Abdullah & Tumeran, 2019).The measurement value to determine difficulty is between the range of +3.00 logit and -3.00 logit, which is considered sufficient. (Andrich & Styles, 2004; Hill & Koekemoer, 2013; Linacre, 1994). In this regard, Bambang & Wahyu (2014) state that information through the determination of measure values can also be used to identify the level of difficulty of items in an instrument by dividing measure values into four (4) categories, namely, very difficult items (measure > 1 logit), difficult items (measure 0.0 logit to 1 logit), easy items (measure 0.0 logit to -1 logit), and very easy items (measure < -1 logit). This distribution map can be generated by selecting the "12. Item: map" menu on the Output Table in the WINSTEPS software (Basran, 2021). The resulting Wright Map is then useful in determining the level of ability of an item based on respondent feedback on a matter to be studied. The advantage of the Rasch measurement model through the Wright Map is that it can describe the relationship between the distribution of respondents' abilities or tendencies (Bond & Fox, 2015). Through Wright Map and determining the measure value, an assessment can be made of the item's characteristics by comparing the item's difficulty level with the actual difficulty level of the item in a data set (Boone et al., 2014). This means that the results of the analysis of the respondent-item distribution map on a logit scale through the Wright Map can determine the extent to which the item's ability to be implemented reflects the position of the measured variable.

3. Research Findings

Feedback regarding the acceptance of STEM implementation involving secondary school teachers in Labuan was analysed using Wright Map. Through the results in figure 1, statistically revealing aspects that are strengths and weaknesses in the acceptance of the actual implementation of STEM, and then giving useful information for decision-makers towards improving the acceptance of STEM implementation for secondary school teachers in Labuan.

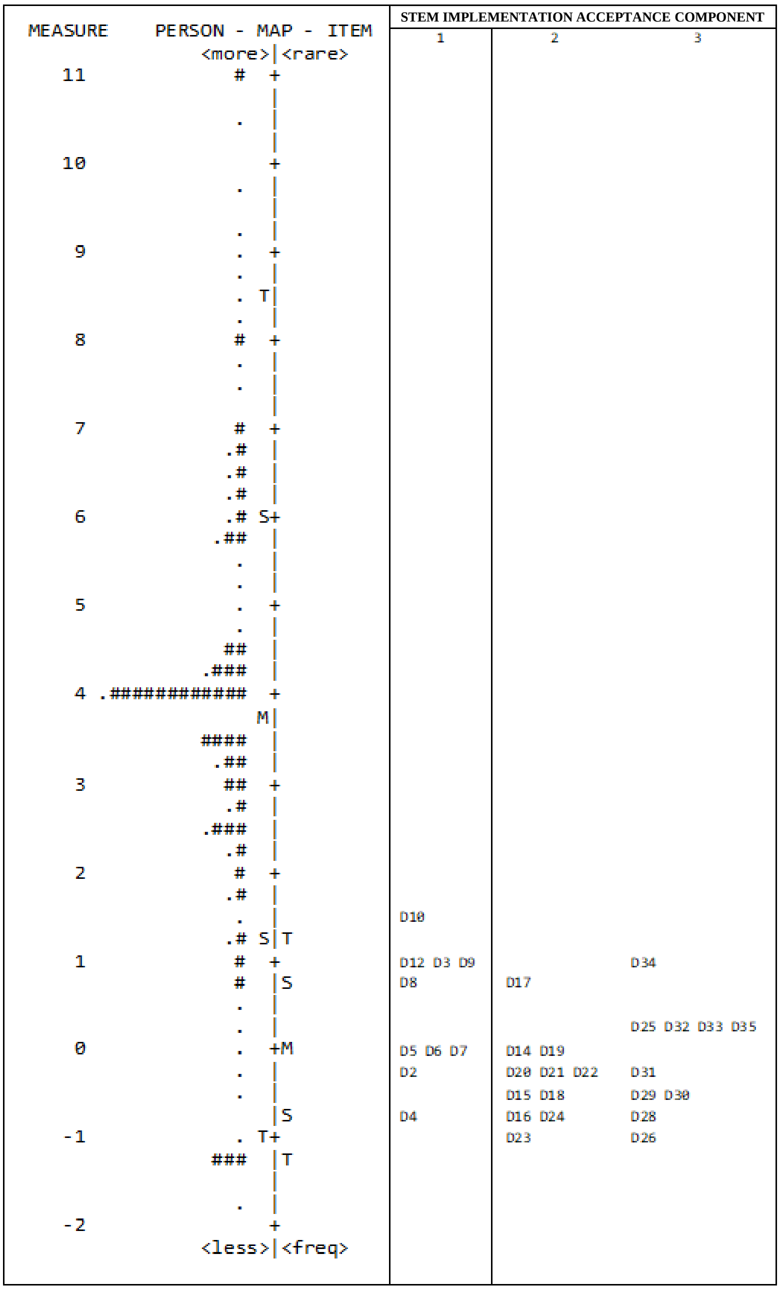

Fig. 1. Wright Map Distribution of STEM Implementation Acceptance Items

The details of the measure value analysis involving the acceptance of STEM implementation are shown in Table 4 and Table 5. The results of the study display the distribution of respondents items in detail through Wright Map and also through the measure value according to the items and components of the STEM implementation acceptance aspect studied. It was found that all items representing the STEM implementation acceptance aspect were at measure values with a range of -0.95 logit to 1.54 logit in Table 4, meeting the difficulty measure in the recommended range of +3.00 logit to -3.00 logit, which is considered good and sufficient (Andrich & Styles, 2004; Hill & Koekemoer, 2013; Linacre, 1994). The details of the measure value analysis involving the acceptance of STEM implementation are shown in Table 4 and Table 5. The results of the study display the distribution of respondents items in detail through Wright Map and also through the measure value according to the items and components of the STEM implementation acceptance aspect studied. It was found that all items representing the STEM implementation acceptance aspect were at measure values with a range of -0.95 logit to 1.54 logit in Table 4, meeting the difficulty measure in the recommended range of +3.00 logit to -3.00 logit, which is considered good and sufficient.

Table 4. Measure Values According to Item Difficulty Level

No.	STEM Implementation Acceptance Items	Value Measure	Level Difficulty
D10	quantitative prediction using mathematical disciplines	1.54	Very Difficult
D34	reduce student stress over public exams	1.09	Very Difficult
D9	the ability to develop a model to solve a problem	1.07	Very Difficult
D3	aligning STEM implementation with teaching and learning	0.98	Difficult
D12	perform the scientific process (collecting, analysing, interpreting,	0.96	Difficult
D8	to conduct an investigation into a matter	0.73	Difficult
D17	to commit more than necessary	0.69	Difficult
D32	found that the teaching and learning conducted was more	0.31	Difficult
D35	apply generic skills (leadership and communication)	0.26	Difficult
D25	ready for any task given by the administrator	0.18	Difficult
D33	able to improve students' higher-order thinking skills	0.18	Difficult
D19	confident in implementing teaching and learning	0.01	Difficult
D6	master the content of the lesson	-0.01	Easy
D5	presenting the product results	-0.05	Easy
D7	explore problems in the real world	-0.05	Easy
D14	divide your time wisely	-0.08	Easy
D2	teaching and learning that encourages student engagement	-0.14	Easy
D21	interested in implementing teaching and learning	-0.14	Easy
D22	motivated to implement teaching and learning	-0.18	Easy
D20	enjoy implementing teaching and learning	-0.27	Easy
D31	able to improve aspects of student knowledge	-0.34	Easy
D15	plan tasks in advance	-0.42	Easy
D18	asking for professional help from colleagues	-0.45	Easy
D29	able to track students' mastery of topics	-0.51	Easy
D30	diversifying methods in implementing teaching and learning	-0.58	Easy
D28	carry out teaching and learning more systematically	-0.69	Easy
D4	foster positive values	-0.71	Easy
D16	prioritize teamwork	-0.75	Easy
D24	reflect at the end of each teaching and learning session	-0.79	Easy
D23	happy with my job as a teacher	-0.90	Easy
D26	make improvements in the delivery of teaching and learning	-0.95	Easy

Table 4 displays the distribution of measure values of items arranged according to the level of difficulty of the items for the aspect of acceptance of STEM implementation in teaching and learning. There are two items from the component of teacher belief about the importance of STEM practices (D10, D34) and one item from the component of teacher commitment in STEM implementation (D34) identified as having a measure value >1 logit, which is in the range of 1.07 logit to 1.54 logit. The results in Table 5 and Figure 1 display the mean measure value for the component of teacher belief about the importance of STEM practices as 0.43 logit, which is interpreted as a very difficult component in the aspect of acceptance of STEM implementation in Labuan. The position of these three items and components is explained as very difficult to agree on based on the respondent feedback in this study because the value measure >1 logit is considered a very difficult item (Bambang & Wahyu, 2014). This means that things like making quantitative predictions using mathematical disciplines, reducing student pressure on public examinations, and the ability to develop models to solve a problem are identified as things that are very difficult for teachers to agree to accept throughout the implementation of STEM in teaching and learning in secondary schools. Acceptance in this matter gives the impression that teachers find it difficult to believe in the importance of these matters and are thus identified as being difficult to commit to implementing them in schools.

The findings in Table 4 describe that there are 9 items identified as being in the measure range of 0.01 logit to 0.98 logit. The positions of the items are detailed in Table 5, which consists of four items of the teacher commitment component in the implementation of STEM (D25, D32, D33, D35), three items of the teacher belief component about the importance of STEM practices (D3, D8, D12), and two items of the teacher attitude component towards the implementation of STEM (D17, D19). It was found that the mean measure value for the teacher belief component about the importance of STEM practices was -0.30 logit, while the mean measure value of the teacher commitment component in the implementation of STEM was -0.11 logit. The positions of these items and components were explained as difficult to agree to accept based on the respondent's feedback because the value is measured in the range of 0.0 logit to 1 logit, which is considered a difficult item (Bambang & Wahyu, 2014). Because the position of these items in the Wright Map is observed to be in this range categorized as difficult items, this gives the interpretation that teachers school secondary schools in Labuan Province find it difficult to agree on the following things; difficult to adapt the implementation of STEM with the objectives of teaching and learning, difficult to carry out scientific processes (collecting, analyzing, interpreting and presenting data), difficult to conduct investigations into a matter, difficult to commit more than necessary, difficult to ensure that the teaching and learning carried out is more effective, difficult to apply generic skills (leadership and communication), difficult to be prepared for any task given by the administrator, difficult to improve students' higher-order thinking skills and difficult to implement STEM teaching and learning. The results of the analysis of teacher feedback concluded that teachers in secondary schools in Labuan have still not received the matters that have been stated well.

The findings in Table 4 show that there are 19 items identified as being in the measure range of -0.01 logit to -0.95 logit. The items consist of nine items from the component of teacher attitude towards STEM implementation (D14, D15, D16, D18, D20, D21, D22, D23, D24), five items each for the component of teacher belief about the importance of STEM practices (D2, D4, D5, D6, D7), and also the component of teacher commitment in STEM implementation (D26, D28, D29, D30, D31). Table 4 summarises the mean measure value for the component of teacher attitude towards STEM implementation as -0.30 logit, and the component of teacher commitment in STEM implementation is -0.11 logit. The positions of these components and items are identified as being in the range of measure 0.0 logit to -1 logit, which is considered easy to implement (Bambang & Wahyu, 2014). Analysis This means that the aspect of accepting the implementation of STEM in teaching and learning, especially involving the components of teacher attitude and teacher commitment towards the implementation of STEM in teaching and learning, is identified as a component that is easily accepted and agreed upon by respondents in this study.

Table 5. Measure Value by Item and Component

No.	Components / Items of STEM Implementation Acceptance	Measure Items	Difficulty Items	Mean Measure
	Teachers' Beliefs About the Importance of STEM Practices			
D2	teaching and learning that encourages student engagement	-0.14	Easy	0.43 (Difficult)
D3	aligning STEM implementation with teaching and learning objectives	0.98	Difficult	
D4	foster positive values	-0.71	Easy	
D5	presenting the product results	-0.05	Easy	
D6	master the content of the lesson	-0.01	Easy	
D7	explore problems in the real world	-0.05	Easy	
D8	to conduct an investigation into a matter	0.73	Difficult	
D9	the ability to develop a model to solve a problem	1.07	Very Difficult	
D10	quantitative prediction using mathematical disciplines	1.54	Very Difficult	
D12	perform the scientific process (collect, analyse, interpret and present data)	0.96	Difficult	
	Teachers' Attitudes Towards STEM Implementation			
D14	divide your time wisely	-0.08	Easy	-0.30 (Easy)
D15	plan tasks in advance	-0.42	Easy	
D16	prioritize teamwork	-0.75	Easy	
D17	to commit more than necessary	0.69	Difficult	
D18	asking for professional help from colleagues	-0.45	Easy	

No.	Components / Items of STEM Implementation Acceptance	Measure Items	Difficulty Items	Mean Measure
D19	confident in implementing teaching and learning	0.01	Difficult	
D20	enjoy implementing teaching and learning	-0.27	Easy	
D21	interested in implementing teaching and learning	-0.14	Easy	
D22	motivated to implement teaching and learning	-0.18	Easy	
D23	happy with my job as a teacher	-0.90	Easy	
D24	reflect at the end of each teaching and learning session	-0.79	Easy	
	Teacher Commitment in STEM Implementation			
D25	ready for any task given by the administrator	0.18	Difficult	-0.11 (Easy)
D26	make improvements in the delivery of teaching and learning	-0.95	Easy	
D28	carry out teaching and learning more systematically	-0.69	Easy	
D29	able to track students' mastery of topics	-0.51	Easy	
D30	diversifying methods in implementing teaching and learning	-0.58	Easy	
D31	able to improve aspects of student knowledge	-0.34	Easy	
D32	found that the teaching and learning conducted was more effective	0.31	Difficult	
D33	able to improve students' higher-order thinking skills	0.18	Difficult	
D34	reduce student stress over public exams	1.09	Very Difficult	
D35	apply generic skills (leadership and communication)	0.26	Difficult	

Table 5 shows the mean measure of acceptance of STEM implementation in teaching and learning according to components. It was found that the mean measure value of the component of teachers' beliefs about the importance of STEM practices is 0.43 logit, the component of teachers' attitudes towards STEM implementation is -0.30 logit, and the component of teachers' commitment in STEM implementation is -0.11 logit. The component in the aspect of acceptance of STEM implementation that shows the highest mean measure value is the component of teachers' beliefs, which is 0.43 logit, and the lowest value is the component of teachers' commitment, which is -0.11 logit. From the aspect of acceptance of STEM implementation in teaching and learning, it was found that the component that is very difficult to agree with is the component of teachers' beliefs, while the component that is very easy to agree with is the component of teachers' commitment. Figure 1 shows the distribution of respondents items through Wright Map; it was found the distribution of items in the teacher belief component is above the mean value of the respondent's ability, except for items D2 and D4. For the teacher attitude component, it is identified to be below the mean value of the respondent's ability except for items D17, D14, and D19, while the teacher commitment component items are balanced, namely items D34, D25, D32, D33, and D35 are above the respondent's mean ability value, and items D31, D29, D30, D28, and D26 are below the respondent's mean ability value. It was found that the most difficult item in the aspect of teacher acceptance is item D10, and the easiest item is item D26.

The results of the Wright Map and Measure analysis indicate that teachers' belief in the importance of STEM practices is the most challenging component to accept and implement among secondary school teachers in Labuan. Overall, teachers expressed difficulty in believing that STEM practices such as making quantitative predictions using mathematics and developing problem-solving models can be effectively implemented in teaching and learning. Teachers also struggled to align STEM with instructional objectives, conduct scientific processes, and perform investigative tasks. These difficulties suggest that teachers are not yet fully prepared to embrace and apply these practices in real classroom contexts. Although they acknowledge the importance of STEM, teachers admitted that its implementation remains unclear and not yet fully mastered. Nevertheless, teachers showed strength in accepting STEM practices that involve student engagement, value formation, product presentation, content mastery, and real-world problem exploration. These findings are supported by Ramli (2020), who found that teacher acceptance of STEM instruction increases when it directly involves student interaction. This indicates that teachers' acceptance is selective and context-dependent based on their actual teaching environment. Relating these findings to the Theory of Reasoned Action by Fishbein & Ajzen (1975), teacher belief in the feasibility of STEM implementation plays a critical role in triggering their behavioural intention and actual behaviour. Low belief in challenging components like mathematical forecasting and model development affects their readiness to adopt STEM-based instructional approaches. Copriady (2014) highlights that belief supports teachers in determining instructional scope, identifying student capabilities, and enhancing confidence in their teaching effectiveness. Shumow & Miller (2001) further demonstrate that high levels of teacher belief can act as a catalyst for achieving educational goals, while Thorndike (1997) emphasises that positive belief fosters performance, whereas negative belief leads to reluctance.

Practically, these findings offer crucial input to the Ministry of Education Malaysia (MOE) for designing more targeted professional development programmes, particularly those aimed at strengthening teacher belief in complex STEM components. Training should emphasise deep understanding of STEM applications in teaching, especially regarding mathematical prediction and model-based instruction. Turgut et al. (2024) recommend the development of tailored assessment tools for evaluating STEM teachers' technological pedagogical knowledge. Additionally, models such as UTAUT (Venkatesh et al., 2003) and TAM (Davis, 1989) underscore the role of perceived effectiveness and ease of use in determining teacher acceptance of innovation. Comparatively, Zhou et al. (2022) found that teachers in China more readily accepted STEM implementation when provided with targeted training and sufficient resources. In contrast, teachers in Labuan still perceive STEM implementation as highly challenging, reflecting limited exposure and practical experience. is echoed in the studies by Tagupa & Arnado (2024) and Qudratuddarsi (2022), which support the use of Rasch analysis in identifying difficult items that require targeted attention. This study highlights an urgent need to tailor teacher training strategies to focus on belief components identified as key challenges. Intervention programmes should align with the most difficult items identified, as recommended by Rahman (2020) who advocate using Rasch analysis to guide effective intervention planning.

4. Conclusion

In conclusion, the study's findings reveal that secondary school teachers in Labuan exhibit a strong trust in the teaching and learning process, believing it effectively promotes student engagement, cultivates positive values, enables students to present their work, ensures mastery of lesson content, and encourages exploration of real-world problems. Regarding teachers' attitudes, they indicated a propensity to readily demonstrate the following behaviours: efficiently allocating time for advance assignment planning, prioritising collaboration, seeking professional assistance from colleagues, deriving enjoyment from the teaching and learning process, maintaining interest and motivation in teaching, experiencing satisfaction with their profession, and engaging in reflective practices after each instructional session. In terms of teacher dedication, it was observed that educators showed a notable proficiency in fulfilling their responsibilities, particularly in executing teaching and learning activities in a more organised manner. Educators indicated that they it straightforward to assess students' grasp of subjects and to diversify instructional approaches, and they noted that they may easily use measures to enhance students' knowledge in various areas.

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