GERMANE
GLOBAL JOURNAL OF
EDUCATIONAL RESEARCH & MANAGEMENT

e-ISSN : 2805-4695 https://jurnal.nun-g.com/index.php/germane

Validity and Reliability of Learning Motivation and Self-Regulation in Science Learning Questionnaire for Secondary School Students

Wan Mazlina Wan Mehammud[1] & Nur Jahan Ahmad[2]

[1,2] School of Education Studies, Universiti Sains Malaysia, 11800 Pulau Pinang, Malaysia

Corresponding author: jahan@usm.my

Received: 21 October 2024 | Accepted: 15 December 2024 | Published: 25 December 2024

Abstract: Some studies have been conducted to ascertain the degree of learning motivation and self-regulation among secondary school students in science teaching. In the classroom, student engagement with science learning is thought to have been influenced by both student motivation and self-regulation regarding their efforts to succeed. The development of an instrument to assess learning motivation and self-regulation towards science learning among secondary school students in a Malaysian context was conducted in this study. The aim of this study focused on determining validity and reliability processes that were carried out to establish questionnaire measuring learning motivation and self-regulation scale among secondary school students during activity science learning in schools. This questionnaire was adapted from Learning Motivation and Self-Regulation in Science Learning Questionnaire used before. The validity of all items in this questionnaire was checked and verified by three (3) experts. The structure of the items were reviewed using content validity index (CVI) rates and received feedback from the experts. According to face validity analysis which was conducted, the instrument with total of 31 items was validated and the S-CVI/Ave value is 0.96. A pilot study was conducted with 39 respondents to determine the validity and reliability of the instrument to assess self-regulation in learning science among Malaysian secondary school students. The Cronbach Alpha coefficient for scale using 5-point Likert series showed a score of 0.97, thus establishing validity and reliablity of this instrument on learning motivation and self regulation on science learning.

Keywords: Learning Motivation, Self-Regulation, Science Learning, Validity, Reliability

Cite this article: Wan Mazlina Wan Mehammud & Nur Jahan Ahmad. (2024). Validity and Reliability of Learning Motivation and Self-Regulation in Science Learning Questionnaire for Secondary School Students. *Global Journal of Educational Research and Management (GERMANE), 4* (4), p. 56-70.

INTRODUCTION

Science and related disciplines such as biology, chemistry, and physics are crucial courses in the classroom. Students can learn a great deal of pertinent knowledge and develop both their critical and creative thinking abilities by studying these areas. In addition to being able to memorize data, students possessing higher-order thinking skills can also come up with many ways to address a given problem. Even though science is acknowledged as an empirical field, there are numerous instances in which scientific explanations are constructed by the application of imagination or creativity (Stuart, 2019). Accordingly, one of the current demands on the

2024. Vol 4. No 4. pg 56-70. e-ISSN: 2805-4695

educational system is to develop students who possess a thorough understanding of their academic field and who can apply that knowledge to solve problems and create better systems, products, and services (Mohamad Sattar Rasul et al., 2018).

Through the study of science subjects or any other related science disciplines, students can acquire 21st-century abilities like critical and creative thinking. For students to perform to the best of their abilities in science classes, they must have strong learning motivation and self-regulation. Self-assessment techniques in STEM fields help teach students how to critically analyze information, solve problems, and evaluate themselves (Yan & Carless, 2021). According to recent studies, students nowadays struggle to control their behavior and maintain their motivation when learning science in the classroom. Students' interest in pursuing a STEM career has also been influenced by parental influence and their motivation to study science (Razali et al., 2018). Additionally, a correlation was found between parents' educational values and their children's attitudes and maths achievement (Arve Fiskerstrand et al., 2024).

Previous research findings indicate that students' motivation for studying is at a modest level, particularly when it comes to learning science. The scientific performance trend of Malaysian students was ascertained by analyzing the Trend in Mathematics and Scientific Studies (TIMSS) for Science Grade 8 from 1999 to 2019. The proportion of Malaysian students who met the advanced TIMSS standards has decreased from 5% to 3% over the previous 20 years (Fatin Aliah Phang et al., 2021). Malaysia has never outperformed the world average overall (Fatin Aliah Phang et al., 2021). This indicates that Malaysia continues to struggle with low scientific accomplishments (Law et al., 2022).

Learning based on self-regulation includes reasoning, metacognition knowledge, metacognition control, and the necessary motivation (Muijs & Bokhove, 2020). Self-regulated learning will also lead to positive academic achievement (Kayacan & Sonmez Ektem, 2019). Thus, interventions aimed at improving students' academic performance should prioritize developing their self-regulated learning skills in addition to increasing their motivation (Anis et al., 2023). Motivation is another significant factor that has an impact on students' learning strategies since it pushes them to develop self-regulation (Hariri et al., 2021). Studies show a significant correlation between students' academic achievement in science and their willingness to learn the topic (Chan & Norlizah, 2017). Teachers should use creative methods to apply learning and students should be given the chance to engage in self-centered learning (Tanti et al., 2020).

Research suggests that students' motivation and self-regulation levels during science class are the main factors influencing their successful learning engagement (Syefrinando et al., 2020). Students' participation in classroom activities depends on both adaptive self-regulated learning and adaptive motivating beliefs (Pintrich, 2000). Therefore, to concentrate on the most effective teaching strategies during science classes, teachers or instructors must collect data from students regarding learning motivation and self-regulation using a valid and trustworthy instrument. To measure students' learning motivation and self-regulation during science class, the researcher attempted to adopt and modify a relevant instrument during this study. The instrument can be used by educators to gather the necessary data so they can plan efficient teaching methods and resources for science classes.

Problem Statement

A major educational concern is highlighted by Malaysian students' falling performance in science education, as indicated by the declining percentage of students attaining the advanced criteria in the Trends in International Mathematics and Science Study (TIMSS). Malaysia has continuously underperformed over the last 20 years; in 2019, only 3% of pupils met the advanced benchmark, down from 5% in 1999 (Fatin Aliah Phang et al., 2021). The continued low performance in science highlights more general problems with student motivation, engagement, and self-regulated learning. Studies indicate that students' motivation and self-control play a crucial role in their ability to study, especially in scientific classes where critical thinking and problem-solving abilities are required (Syefrinando et al., 2020). Nevertheless, these problems are not sufficiently addressed by the teaching methodologies used today, which deters students from really connecting with the subject matter. Additionally, outside variables like parental influence have an impact on students' enthusiasm for pursuing careers in science. Therefore, instructional strategies must be improved with an emphasis on raising students' motivation and capacity for self-regulated learning. If these issues are not resolved, science achievement is expected to continue to deteriorate, which would make it more difficult for Malaysia to develop a workforce that is innovative and knowledgeable in science.

REVIEW OF LITERATURE

Learning Motivation in Science Learning

Zimmerman (2000) proposes that students are more likely to participate in a task that is specified and suitably hard because they are motivated to do so based on how they assess the task in relation to their self-efficacy. According to Amaro et al. (2021) and Sharma and Gupta (2022), extrinsic motivation is generated by external variables such as rewards and punishments, whereas intrinsic motivation stems from an individual's interests and goals. Schürmann et al. (2021) also state that learners may find it difficult to muster the will and energy necessary to finish assignments, get ready for tests, and succeed in their academic endeavors without motivation. Learning motivation and student engagement are related (Nayir, 2017; Wang et al., 2017). Leung (2020) also stated that motivation is a crucial component of self-determination, as it can foster a stronger desire to pursue a career in science by encouraging effort in science learning.

One important factor in motivation during the learning process is self-efficacy (Reeve, 2018). Previous research demonstrates the degree of student motivation for learning science. According to a study by Chan and Norlizah (2017), female students show a significantly higher willingness and motivation than male students to learn science. Additionally, they claimed that there is a significant correlation between students' achievement in science and their motivation to master the subject. Furthermore, a study by Salih et al. (2016) discovered that female students had a higher motivation than male students to learn science.

Extrinsic motivation and academic achievement are related to science learning among college students (Libao, 2016). Haw et al. (2022) also state that the science laboratory learning environment and science learning motivation are important indicators of students' engagement in science. Career decisions also affected motivation to learn science. Results from a study by Razali et al. (2020) indicate that among Malaysian secondary school students, there was a substantial correlation between passion for science and interest in STEM-related careers. According to Hsieh and Yu (2022), when it comes to gaining real-world STEM competency through involvement and engagement in the scientific learning process, motivation is essential.

Self-Regulation in Science Learning

According to Dunford's (2000) Self-Regulation Theory, regulation is strongly tied to a student's surroundings, their ability to modify negative behavior, and their sensitivity to outside forces, all of which help students become more goal-orientated and focused. Self-efficacy processes are a part of self-regulation as well, and they have a significant impact on thinking, influence, motivation, and behavior (Bandura, 1991). Self-regulation encompasses various aspects for

2024. Vol 4. No 4. pg 56-70. e-ISSN: 2805-4695

students, including self-awareness, understanding of their learning styles and shortcomings, self-motivation to participate in the process, and the ability to devise plans and techniques to improve learning (Schunk & Zimmerman, 2011). Pintrich (2000) stated that the ability to master information and self-discipline are examples of the skills that make up self-regulation.

According to Adesola and Li (2018), self-efficacy and cognitive methods as well as self-regulation are highly correlated. Positive academic achievement will also result from self-regulated learning (Kayacan & Sonmez Ektem, 2019). Since self-regulated learning explicitly refers to students' motivational orientation and learning practices, it has also positively and significantly improved academic accomplishment (Cleary & Platten, 2013; Zumbrunn et al., 2011). According to Zimmerman and Schunk (2002), self-regulated learning is the process by which a student fosters his or her academic success through cognitive, behavioral, and motivational means. Lim and Yeo (2021) concluded that aspects such as task value, intrinsic goal orientation, control of learning beliefs, and self-efficacy may all be used as predictors of self-regulated learning.

Many studies have been conducted to determine the level of self-regulation exhibited by students. The teacher's assistance as a facilitator in the self-regulated learning environment helps students' self-regulation, according to a study by Sukro Muhab et al. (2022). During their study of chemistry, the students also assumed more duties and responsibilities. The results of a study by Olakanmi and Gumbo (2017) indicate that it is recommended that secondary science classrooms incorporate the teaching of self-regulated learning since it improves students' performance in chemistry. Research has demonstrated that self-regulated learning significantly improves students' academic achievement, science motivation, and perceived academic self-efficacy Cengiz-Istanbullu & Sakiz, 2022). According to Tanti et al. (2020), there is a significant correlation and impact between students' motivation to learn science and their ability to regulate themselves. According to Lämsä et al. (2023), student reliance on teacher-led assessment was higher than that of self-assessment. An essential component of self-regulated learning is self-assessment, which takes place in several ways at each stage of the self-regulated learning process (Yan, 2019). Additionally, Cabello and Topping (2020) state that peer evaluation and feedback can be very helpful in teacher education because they can help students increase their understanding of key teaching methods and the difficulties of explaining them in actual classroom settings.

Previous Questionnaires Developed to Measure Motivation and Self-Regulation Among Students

Researchers have developed several tools or instruments to evaluate students' self-regulation and motivation. The developed tools or instruments were used to evaluate students' self-regulation and motivation at various levels.

The instruments developed by researchers to measure the motivation level among students that are reported such as the Motivated Strategies for Learning Questionnaire (MSLQ) were developed by Pintrich et al. (1991). The motivational orientations of college students were evaluated using this tool. Subsequently, Glynn et al. (2009) created the Science Motivation Questionnaire (SMQ) to assess university-level scientific students' motivation. Tuan et al. (2005) developed the Students' Motivation towards Science Learning (SMTSL) instrument, which can be used to measure six motivational constructs: self-efficacy, active learning strategies, science learning value, performance objective, achievement goal, and stimulation of the learning environment. The other questionnaire called the Students' Adaptive Learning Engagement in Science Questionnaire, was developed by Velayutham et al. (2011) to evaluate students' motivation and self-regulation. This instrument can be used to gauge students' self-efficacy, self-regulation, learning goal orientation, and task value.

2024. Vol 4. No 4. pg 56-70. e-ISSN: 2805-4695

There are a variety of instruments available for assessing students' self-regulation. The Motivated Strategies for Learning Questionnaire, developed by Pintrich et al. (1991), and the Learning and Study Strategies Inventory, developed by Weinstein et al. (1987) are among the instruments that can be used to evaluate self-regulation learning. These questionnaires were widely used in measuring self-regulation among college students. Brown et al. (1999) created the Self-Regulation Questionnaire to assess self-regulatory processes generally through self-report. These three (3) questionnaires each contained many items—between 63 and 81.

METHODOLOGY

This study focused on the development of the Learning Motivation and Self-Regulation in Science Learning Questionnaire. The questionnaire was adopted and adapted from a previous study and few changes were made based on the suitability of the questionnaire for Malaysian secondary school context. The validity and reliability tests were also done on the newly adapted questionnaire.

Sample

The study's sample was chosen using simple random sampling (SRS) to ensure that it met the academic requirements of the intended research sample. 39 secondary school students were chosen for the study questionnaire trial using simple random sampling (SRS). The responders have 30 minutes to complete this questionnaire. There were 39 responses total; 24 of them were female students and 15 of them were male students. There were 39 respondents in all, including 9 Indians, 1 Chinese, and 29 Malay respondents. The constraints were disregarded because the study's goals were to validate and assess the questionnaire's reliability, notwithstanding the samples' unequal distribution of gender and ethnicity. Three (3) experts were also involved in this study to ensure the questionnaire's content validity. The three (3) experts that participated were from the fields of scientific education and Malay language studies since the questionnaire that was circulated was written in Malay.

Development of Learning Motivation and Self-Regulation in Science Learning Questionnaire

The Learning Motivation and Self-Regulation in Science Learning Questionnaire was adopted and adapted from a previous study that was done by Velayutham et al. (2011). The instrument was selected because it may be used to gauge students' self-regulation and motivation, particularly when learning science. The instrument can be used to gauge how adaptively motivated and engaged the students are in their science classes. The adaptation process was done after several discussions with Science Subject Matter Experts (SME). The Subject Matter Expert was chosen based on the qualification and her expertise in merely the Science or Science, Technology, Engineering, and Mathematics (STEM) field. The initial role of the Science Subject Matter Expert was to check the list of constructs and items included in the newly adapted questionnaire and whether all the constructs and items were appropriate for the targeted samples.

Despite a few minor adjustments, the first check was essential to ensure that the newly modified questionnaire aligned with the original questionnaire, the Students' Adaptive Learning Engagement in Science Questionnaire by Velayutham et al. (2011). When assessing secondary school science students' self-regulation and motivation for studying, the original questionnaire was the better choice. To ensure that the updated questionnaire was appropriate for the most current study, it was necessary to go through the steps of adaptation and modification. The original questions must be modified and reworded to adhere to the necessary standard Malay sentences because the disseminated questionnaire was written in that language.

2024. Vol 4. No 4. pg 56-70. e-ISSN: 2805-4695

The newly modified questionnaire had every one of the 32 items from the original. After translation, most of the elements were reworded to fit more comprehensible Malay language sentences. After multiple conversations with the Science Subject Matter Expert (SME), all the items and constructs remained part of the newly modified questionnaire.

Choices of Scale in Learning Motivation and Self-Regulation in Science Learning Questionnaire

The newly adjusted questionnaire was based on the 5-point Likert scale and was in line with the original Velayutham et al. (2011) questionnaire. There are five (5) scales on the 5-point Likert scale: 1 for strongly disagree, 2 for disagree, 3 for being uncertain, 4 for agree, and 5 for strongly agree. Each of the 32 items in the Learning Motivation and Self-Regulation in Science Learning Questionnaire has five (5) scales from which the respondents can select. The 5-point Likert scale was frequently employed in surveys employing questionnaires to find out respondents' preferred options and opinions.

RESULTS AND DISCUSSION

Three (3) experts in the fields of Malay language studies and scientific education validated the recently modified questionnaire. To determine the S-CVI/Average of the items contained in the recently revised questionnaire; a content validity index (CVI) analysis was performed. The researcher can also get some insights from the content validity index analysis to remove any unneeded items in the questionnaire. To ensure that the recently revised questionnaire is trustworthy and may soon be used in the actual study, a reliability test is essential.

Validation of Learning Motivation and Self-Regulation in Science Learning Questionnaire

To make sure an instrument is dependable and valid for use in research, it must undergo validation and reliability testing. Validity is the extent to which an instrument measures something that must be measured with a certain level of accuracy and truth. In Table 2, the main steps of the validity procedure are listed.

The Learning Motivation and Self-Regulation in Science Learning Questionnaire was validated by three (3) experts in the disciplines of science education and Malay language studies. All the experts are actively involved in their fields of expertise by authoring several articles on their areas of knowledge, producing educational resources, volunteering in the community, and giving presentations or seminars about science or STEM. Table 1 shows the list of experts involved in the validation process.

Table 1. List of experts for validation of an instrument

Expert	Areas of expertise	Academic qualifications	Years of service
1	Science Education, Philosophy of Education, Curriculum Development	PhD (Associate Professor)	More than 10 years
2	Science Education STEM Education	PhD (Dr)	More than 10 years
3	Malay Language Education, Malay Language Studies	PhD (Dr)	More than 5 years

2024. Vol 4. No 4. pg 56-70. e-ISSN: 2805-4695

Yusoff (2019) recommends several steps to be performed to complete the content validity method. The content validity procedures recommended by Yusoff (2019) are displayed in Table 2.

Table 2. Content validity processes

Content validity processes
1. Preparation of content validity form for experts
2. Selecting experts to review the panel
3. Carrying out the procedure for content validation
4. Reviewing constructs and items in the questionnaire
5. Giving a score for every item
6. Calculating Content Validity Index (CVI)

Source: Yusoff (2019)

The Learning Motivation and Self-Regulation in Science Learning Questionnaire was subjected to the content validation process. The content validation form for the experts in this study comprised 32 items with a 10-point rating system. The scale goes from scale 1, which indicates strong disagreement to scale 10, which indicates strong agreement. Each expert received a content validation form with a 10-point rating for each item to be reviewed.

The relevance scale to calculate the Content Validity Index (CVI) was either 1 or 0. The relevance scale was 0 for items rated between scales 1 and 5, and 1 for items rated between scales 6 and 10. According to Yusoff (2019), items scored 1 or 2 should have a relevance score of 0 while items scored 3 or 4 should have a relevance score of 1. Items scored 1 or 2 correspond with items scored 1 to 5 in this study while items scored 3 or 4 correspond with items scored 6 to 10 in this study.

The number of experts in agreement divided by the total number of experts involved is used to calculate the Content Validity Index (CVI) by items. If all three experts agreed with the items, the universal agreement (UA) score was 1, and if only one or two experts agreed, the score was 0. According to Polit et al. (2007), a CVI value of one is appropriate for three (3) to five (5) experts. The Content Validity Index (CVI) computation is displayed in Table 3.

Table 3. Content validity index calculation

Items	Expert 1	Expert 2	Expert 3	No expert agreement	I-CVI	UA
1	1	1	1	3	1.00	1
2	1	1	1	3	1.00	1
3	1	1	1	3	1.00	1
4	1	1	1	3	1.00	1
5	1	1	1	3	1.00	1
6	1	1	1	3	1.00	1
7	1	1	1	3	1.00	1
8	1	1	1	3	1.00	1
9	1	1	1	3	1.00	1
10	1	1	1	3	1.00	1

2024. Vol 4. No 4. pg 56-70. e-ISSN: 2805-4695

11	1	1	1	3	1.00	1
12	0	0	1	1	0.30	0
13	0	1	1	2	0.70	0
14	1	0	1	2	0.70	0
15	1	1	1	3	1.00	1
16	1	1	1	3	1.00	1
17	1	1	1	3	1.00	1
18	1	1	1	3	1.00	1
19	1	1	1	3	1.00	1
20	1	1	1	3	1.00	1
21	1	1	1	3	1.00	1
22	1	0	1	2	0.70	0
23	1	0	1	2	0.70	0
24	1	1	1	1	1.00	1
25	1	1	1	1	1.00	1
26	1	1	1	1	1.00	1
27	1	1	1	1	1.00	1
28	1	1	1	1	1.00	1
29	1	1	1	1	1.00	1
30	1	1	1	1	1.00	1
31	1	1	1	1	1.00	1
32	1	1	1	1	1.00	1

CVI analysis demonstrates that four (4) items have an I-CVI value of 0.7 and 27 items have an I-CVI value of 1. One item has a 0.3 I-CVI value. Additionally, this shows that most of the items have a score of 1 for Universal Agreement (UA) rather than 0. The content validity index (CVI) analysis in Table 4 allows for the calculation of the average I-CVI (S-CVI/Ave). For the 32 items that were included, the S-CVI/Ave acquired value was 0.94. The researchers also discovered that when item 12 is eliminated from the questionnaire, the S-CVI/Ave value will be 0.96. The removal of item 12 will be considered for better S-CVI/Ave value to increase the validity of the questionnaire for usage in research.

The results of the analysis for items (I-CVI) that are more than 0.79 are relevant, while I-CVI values between 0.70 and 0.79 require re-evaluation, according to Rodrigues et al. (2017). Items on the questionnaire that have an I-CVI value of less than 0.70 ought to be eliminated. As a result, item 12, out of the 32 total items in the questionnaire, was removed because of its I-CVI score of 0.30. The I-CVI values of the remaining 27 items are 1.00, whereas the I-CVI values of four (4) items have been re-evaluated because they are 0.70. The experts' recommendations served as the basis for the re-evaluation procedure for the four (4) items. An S-CVI/Ave score of 0.96 was obtained from the Content Validity Index (CVI) analysis, indicating that this instrument can be used for real research in the future. Thus, this validated questionnaire will be tested for reliability.

Reliability of Learning Motivation and Self-Regulation in Science Learning Questionnaire

Reliability, according to Creswell and Creswell (2018), pertains to two conditions: a measure's consistency and its stability over time. Following the validation procedure, a pilot test will be done to assess the questionnaire's reliability. 39 secondary school students participated in the pilot study of the new questionnaire. According to Isaac and Michael's (1982) recommendations, a sample size of between 10 and 30 people is necessary for the pilot study's objectives, therefore this number of students is adequate for that purpose. Tsang et al. (2017) state that to obtain a high-reliability value for every questionnaire item, 30 to 50 samples of respondents are required for the pilot test.

The researcher utilized the Statistical Package for Social Science (SPSS) version 27 to calculate the reliability of the questionnaire items since the manual calculation is difficult. An outcome of 0.97 was obtained from the reliability test of the Learning Motivation and Self-Regulation in Science Learning Questionnaires. Cronbach's Alpha levels between 0.65 and 0.95 are considered satisfactory by Chua (2011), while values of 0.96 and higher are excellent and appropriate for use as research tools. The Learning Motivation and Self-Regulation in Science Learning Questionnaire has a high coefficient reading that makes it appropriate for use in actual research.

Additionally, Cronbach's Alpha values for every construct in this questionnaire have been acquired. The Alpha coefficient value for the Learning Goal Orientation construct is 0.95 and the Alpha coefficient value for the Task Value construct is 0.91. The Alpha coefficient value for the Self-Efficacy construct is 0.90 while the Alpha coefficient value for the Self-Regulation construct is 0.93, according to the analysis conducted using SPSS version 27. This implies the reliability of the constructs and items in this questionnaire. The Cronbach's Alpha values for each construct are displayed in Table 4.

Table 4. Cronbach's Alpha Value

Construct(s)	Cronbach's Alpha value
Learning Goal Orientation	0.95
Task Value	0.91
Self-Efficacy	0.90
Self-Regulation	0.93

Discussion

This study's main objective was to adopt and modify a questionnaire. The SALES questionnaire by Velayutham et al. (2011) was developed based on the research to measure students' motivation and self-regulation in science. The researcher subsequently made changes to the adopted questionnaire by paraphrasing some of the sentences. To make sure that the context and meaning of the items remain the same when translated into Malay, this paraphrase phase was essential. The original questionnaire was modified, enabling the researcher to create a new questionnaire that has been translated and adjusted. With just minor word and paraphrasing changes, the questionnaire's constructs and items remain unchanged. The 32-item questionnaire was evaluated by three (3) experts chosen based on their areas of expertise once it had been adapted. Additionally, copies of the questionnaire's original English form were given to each participating expert. As stated by Escobar-Pérez and Cuervo-Martínez (2008) in Fernández-

Gómez et al. (2020), selecting experts who are recognized in the community, have professional experience or have an educational background is essential for instruments' validation.

One (1) item out of the questionnaire's 32 items was suggested for elimination since its meaning is the same as another item. The item's removal also results in a 0.94 to 0.96 S-CVI/Ave value shift. Despite the slight variation in the S-CVI/Ave, this indicates that the removal of a single item can improve an instrument's reliability. Rodrigues et al. (2017) state that the CVI analysis results for items that are more than 0.79 are meaningful, whereas I-CVI values between 0.70 and 0.79 demand re-evaluation. After the questionnaire is translated into Malay, it appears that the removed item and another item have the same meaning. This demonstrates how two different English terms translated into Malay may have the same meaning. Thus, it is recommended to eliminate the required item to increase the credibility of the questionnaire. It was necessary to preserve the terms' original meanings in the original language (Lee et al. 2012). Thus, it is crucial that the original meaning of the English questionnaires be preserved in the Malay translations.

A pilot study including 39 secondary school students enrolled in science classes was used to assess reliability. Every student in the secondary school was in the same grade. The chosen school granted permission for the pilot test to be administered to the pupils. A science teacher at the school assisted in briefing and distributing the questionnaire since it was distributed online. The school's collaboration made it easier for the researcher to carry out the pilot test. Using the SPSS version 27, the reliability test of the newly modified questionnaire revealed a Cronbach's Alpha score of 0.97. Chua (2011) states that Cronbach's Alpha values ranging from 0.65 to 0.95 are deemed adequate, whilst values over 0.96 are exceptional and suitable for employment as research instruments. This suggests that this tool can be used to gather actual data for research.

This new questionnaire consisted of 31 items in total. A suitable number of items can be employed to evaluate students' self-control and enthusiasm for studying science. A well-designed questionnaire should have 25–30 items and take less than 30 minutes to complete to keep participants interested and focused (Sharma, 2022). As the number of questions increases, participants have been observed to speed through or satiate their curiosity, which has a negative effect on answer rates, quality and reliability (Sharma, 2022). Thus, the recently modified questionnaire can also be used by science teachers to assess secondary school students' learning goal orientation, task value, self-efficacy and self-regulation, particularly in science classes. Science teachers in science classrooms will receive information from the assessment regarding how to design courses and teaching materials, based on the students' readiness.

CONCLUSION

This study's primary contribution was the validation and reliability testing of a recently modified questionnaire designed to measure secondary school students in Malaysia's motivation to learn and level of self-regulation in studying science. The study successfully adopted and adapted the Students' Adaptive Learning Engagement in Science Questionnaire to effectively assess motivation and self-regulation in science among secondary school students in Malaysia. Through a meticulous process of translation and cultural adaptation, the questionnaire was refined to ensure its relevance and applicability in the local educational context. This adapted questionnaire not only contributes to the field of educational research but also provides a valuable tool for science teachers to assess and enhance their students' learning engagement and self-regulatory skills, ultimately improving science education in Malaysia.

In addition, there are several implications of the study which include enhanced teaching strategies. For instance, the findings from this study can inform science teachers about the specific motivational and self-regulatory needs of their students, enabling them to develop more effective teaching strategies that cater to these needs. Also, by understanding the factors that influence students' motivation and self-regulation, teachers can create a more engaging and supportive learning environment. Furthermore, the results can assist teachers to improve student outcomes. This can be done by addressing students' motivational and self-regulatory challenges can lead to improved academic performance and a deeper understanding of scientific concepts. Students who are more motivated and capable of self-regulation are likely to achieve better results in their science courses and may be more inclined to pursue STEM-related careers.

For future recommendations, the modified questionnaire can be utilized in other pure science courses, such as biology, chemistry, and physics. Although initially designed to assess secondary school students' self-regulation and motivation for learning science, the questionnaire's items can be adapted to better suit various subjects. This flexibility allows for a broader application of the questionnaire across different science disciplines, enhancing its utility for both researchers and educators. Additionally, further research could explore the application of the questionnaire in different educational settings and cultural contexts to validate its effectiveness and generalizability.

REFERENCES

Adesola, S. A., & Li, Y. (2018). The relationship between self-regulation, self-efficacy, test anxiety and motivation. International Journal of Information and Education Technology, 8(10), 759-763.

Albert Bandura. (1991). Social Cognitive Theory of Self-Regulation. Organizational Behavior and Human Decision Processes 50, 248-287.

Amaro, H., Sanchez, M., Bautista, T., & Cox, R. (2021). Social vulnerabilities for substance use: Stressors, socially toxic environments, and discrimination and racism. Neuropharmacology, 188, Article 108518. https://doi.org/10.1016/J. NEUROPHARM.2021.108518

Anis, N., Hamid, A., Singh, K., & Noor Hanim Rahmat. (2023). Exploring Motivational Beliefs and Self-Regulated Learning Strategies in Learning among Undergraduates. International Journal of Academic Research in Business & Social Sciences, 13(7). https://doi.org/10.6007/ijarbss/v13-i7/17043

Arve Fiskerstrand, Hannula, M. S., & Arne Kåre Topphol. (2024). Parental involvement and children's mathematical outcomes. LUMAT International Journal on Math Science and Technology Education, 12(3), 6–6. https://doi.org/10.31129/lumat.12.3.2146

Brown, J. M., Miller, W. R., & Lawendowski, L. A. (1999). The self-regulation questionnaire. In L. VandeCreek & T. L. Jackson (Eds.), Innovations in clinical practice: A source book, Vol. 17, pp. 281–292). Professional Resource Press/Professional Resource Exchange.

Cabello, V., & Topping, K. J. (2020). Pre-service teachers' conceptions about the quality of explanations for the science classroom in the context of peer assessment. LUMAT: International Journal on Math, Science and Technology Education, 8(1). https://doi.org/10.31129/lumat.8.1.1416

Cengiz-Istanbullu, B., & Sakiz, G. (2022). SELF-REGULATED LEARNING STRATEGIES IMPACT FOURTH-GRADE STUDENTS' POSITIVE OUTCOMES IN SCIENCE CLASS. Journal of Baltic Science Education, 21(2), 192–206. https://doi.org/10.33225/jbse/22.21.192

Chan Y.L & Norlizah C.H. (2017). Students' Motivation towards Science Learning and Students' Science Achievement. International Journal of Academic Research in Progressive Education and Development, 6(4), 174-189.

Chua, Y.P. (2011). Research methods and statistics: Research methods. Edisi Kedua. Shah Alam: McGraw Hill.

Cleary, T. J., & Platten, P. (2013). Examining the correspondence between self-regulated learning and academic achievement: A case study analysis. Education Research International, 2013, 1-18. https://doi.org/10.1155/2013/272560

Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and Mixed Methods Approaches (5th ed.). SAGE Publications.

Dunford, M. (2000). Globalization and theories of regulation. In R. Polan (ed), 143-167, Global Political Economy: Contemporary Theories, London: Routledge.U.K.

Eunice Eyitayo Olakanmi, & Gumbo, M. T. (2017). The Effects of Self-Regulated Learning Training on Students' Metacognition and Achievement in Chemistry. International Journal of Innovation in Science and Mathematics Education, 25(2).

Escobar-Pérez, J., & Cuervo-Martínez, A. (2008). VALIDEZ DE CONTENIDO Y JUICIO DE EXPERTOS: UNA APROXIMACIÓN A SU UTILIZACIÓN. Avances en Medición, 6, 27–36.

Fatin Aliah Phang, Khamis, N., Nina Diana Nawi, & Jaysuman Pusppanathan. (2021). TIMSS 2019 Science Grade 8: Where is Malaysia standing? Asean Journal of Engineering Education, 4(2). https://doi.org/10.11113/ajee2020.4n2.10

Fernández-Gómez, E., Martín-Salvador, A., Luque-Vara, T., Sánchez-Ojeda, M. A., Navarro-Prado, S., & Enrique-Mirón, C. (2020). Content Validation through Expert Judgement of an Instrument on the Nutritional Knowledge, Beliefs, and Habits of Pregnant Women. Nutrients, 12(4), 1136. https://doi.org/10.3390/nu12041136

Glynn, S. M., Taasoobshirazi, G., & Brickman, P. (2009). Science motivation questionnaire: Construct validation with nonscience majors. Journal of Research in Science Teaching, 46, 127–146.

Hariri, H., Karwan, D.H., Haenilah, E.Y., Rini, R., & Suparman, U. (2021). Motivation and learning strategies: Student motivation affects student learning strategies. European Journal of Educational Research, 10(1), 39-49. https://doi.org/10.12973/eu-jer.10.1.39

Haw, L. H., Sharif, S. B., & Han, C. G. K. (2022). Predictors of Student Engagement in Science Learning: The Role of Science Laboratory Learning Environment and Science Learning Motivation. Asia Pacific Journal of Educators and Education, 37(2), 225–245. https://doi.org/10.21315/apjee2022.37.2.11

Hsieh, T.-L., & Yu, P. (2022). Exploring achievement motivation, student engagement, and learning outcomes for STEM college students in Taiwan through the lenses of gender differences and multiple pathways. Research in Science & Technological Education, 1–16. https://doi.org/10.1080/02635143.2021.1983796

Isaac, S., & Michael, W. B. (1982). Handbook in research and evaluation: a collection of principles, methods, and strategies useful in the planning, design, and evaluation of studies in education and the behavioral sciences. Edits Publishers.

Kayacan, K., & Sonmez Ektem, I. (2019). The effects of biology laboratory practices supported with self- regulated learning strategies on students' self-directed learning readiness and their attitudes towards science experiments. European Journal of Educational Research, 8(1), 313-299. doi: 10.12973/eu-jer.8.1.313

Lämsä, J., Virtanen, A., Tynjälä, P., Maunuksela, J., & Koskinen, P. (2023). Exploring students' perceptions of self-assessment in the context of problem solving in STEM. LUMAT, 11(2). https://doi.org/10.31129/LUMAT.11.2.2028

2024. Vol 4. No 4. pg 56-70. e-ISSN: 2805-4695

Law, H. H., Sharif, S., & Han, C. G. K. (2022). Analyzing the science achievement test: Perspective of classical test theory and Rasch analysis. International Journal of Evaluation and Research in Education, 11(4), 1714–1724. https://doi.org/ 10.11591/ ijere.v11i4.22304

Lee, Y. Y., Waid, A., Tan, H. J., Andrew Chua, S. B., & Whitehead, W. E. (2012). Validity and reliability of the Malay-language translation of the Rome III Diagnostic Questionnaire for irritable bowel syndrome. Journal of Gastroenterology and Hepatology, 27(4), 746–750. https://doi.org/10.1111/j.1440-1746.2011.06943.x

Leung, A. (2020). Boundary crossing pedagogy in STEM education. International Journal of STEM Education, 7(1). https://doi.org/10.1186/s40594-020-00212-9

Lim, S. L., & Yeo, K. J. (2021). A systematic review of the relationship between motivational constructs and self-regulated learning. International Journal of Evaluation and Research in Education (IJERE), 10(1), 330. https://doi.org/10.11591/ijere.v10i1.21006

Salih, M., Mohammed Y.M. Mai, & Abdullah Al Shibli. (2016). Students' motivation toward science learning in secondary schools in Oman and Malaysia: A comparative study. DOAJ (DOAJ: Directory of Open Access Journals).

Muijs, D. and Bokhove, C. (2020). Metacognition and Self-Regulation: Evidence Review. London: Education Endowment Foundation

Nayir, F. (2017). The Relationship between student motivation and class engagement levels. Eurasian Journal of Educational Research, 17(71), 59–78. https://doi.org/10.14689/ ejer.2017.71.4

Pintrich, P. R. (2000). The Role of Goal Orientation in Self-regulated Learning. In Monique Boekaerts, Paul R. Pintrich and Moshe Zeidner (Ed.). Handbook of Self-regulation, 452-502. San Diego: Academic Press

Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1991). Reliability and predictive validity of the Motivated Strategies for Learning Questionnaire (MSLQ). Educational and Psychological Measurement, 53, 801–813.

P. Libao, N. J., B. Sagun, J. J., Tamangan, E. A., P. Pattalitan, A., D. Dupa, M. E., & Bautista, R. G. (2016). Science learning motivation as correlate of students' academic performances. Journal of Technology and Science Education, 6(3), 209. https://doi.org/10.3926/jotse.231

Polit, D. F., Beck, C. T., & Owen, S. V. (2007). Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. Research in Nursing & Health, 30(4), 459–467. https://doi.org/10.1002/nur.20199

Mohamad Sattar Rasul, Norsalehan Zahriman, Halim, L., & Amnah, R. (2018). Impact of integrated STEM smart communities program on students scientific creativity. 13, 80–89.

Razali, F., Manaf, U. K. A., & Ayub, A. F. M. (2020). STEM Education in Malaysia towards Developing a Human Capital through Motivating Science Subject. International Journal of Learning, Teaching and Educational Research, 19(5), 411–422. https://doi.org/10.26803/ijlter.19.5.25

Razali, F., Talib, O., Manaf, U. K. A., & Hassan, S. A. (2018). A Measure of Students Motivation, Attitude and Parental Influence towards Interest in STEM Career among Malaysian Form Four Science Stream Student. International Journal of Academic Research in Business and Social Sciences, 7(14). https://doi.org/10.6007/ijarbss/v7-i14/3665

Reeve, J. (2018). Understanding motivation and emotion. John Wiley & Sons.

Rodrigues, I. B., Adachi, J. D., Beattie, K. A., & MacDermid, J. C. (2017). Development and validation of a new tool to measure the facilitators, barriers and preferences to exercise in people with osteoporosis. BMC Musculoskeletal Disorders, 18(1). https://doi.org/10.1186/s12891-017-1914-5

Schunk, D. H., & Zimmerman, B. (2011). Handbook of Self-Regulation of Learning and Performance. Taylor & Francis.

Schürmann, L., Gaschler, R., & Quaiser-Pohl, C. (2021). Motivation theory in the school context: Differences in preservice and practicing teachers' experience, opinion, and knowledge. European Journal of Psychology of Education, 36, 739–757. https://doi.org/10.1007/s10212-020-00496-z

Sharma, H. (2022). How short or long should be a questionnaire for any research? Researchers dilemma in deciding the appropriate questionnaire length. Saudi Journal of Anaesthesia, 16(1), 65–68. https://doi.org/10.4103/sja.sja_163_21

Sharma, N. P., & Gupta, V. (2022). Human behavior in the social environment. Human Behavior in the Social Environment.https://doi.org/10.4324/9781003195542

Stuart, M. T. (2019). Everyday scientific imagination: A qualitative study of the uses, norms, and pedagogy of imagination in science. Science & Education, 28(6), 711-730.

SUKRO MUHAB, IRWANTO IRWANTO, ALLANAS, E., & EGA YODELA. (2022). IMPROVING STUDENTS' SELF-REGULATION USING ONLINE SELF-REGULATED LEARNING IN CHEMISTRY. Journal of Sustainability Science and Management, 17(10), 1–12. https://doi.org/10.46754/jssm.2022.10.001

Syefrinando, B., Daryanto, M., & Salma, H. (2020). Students' Self-Regulation and Motivation in Learning Science. International Journal of Evaluation and Research in Education, 9(4), 865-873.

Tsang, S., Royse, C., & Terkawi, A. (2017). Guidelines for developing, translating, and validating a questionnaire in perioperative and pain medicine. Saudi Journal of Anaesthesia, 11(5), 80. https://doi.org/10.4103/sja.sja_203_17

Tanti, T., Maison, M., Syefrinando, B., Daryanto, M., & Salma, H. (2020). Students' self-regulation and motivation in learning science. International Journal of Evaluation and Research in Education (IJERE), 9(4), 865. https://doi.org/10.11591/ijere.v9i4.20657

Trochim, W. M., & Donnelly, J. P. (2006). The research methods knowledge base (3rd ed.). Cincinnati, OH: Atomic Dog.

Tuan, H. L., Chin, C. C., & Shieh, S. H. (2005). The development of a questionnaire to measure students' motivation towards science learning. International Journal of Science Education, 27(6), 634-659.

Velayutham, S., Aldridge, J., & Fraser, B. (2011). Development and Validation of an Instrument to Measure Students' Motivation and Self-Regulation in Science Learning. International Journal of Science Education, 33(15), 2159–2179. https://doi.org/10.1080/09500693.2010.541529

Wang, Y., Qiao, D. & Chui, E. (2017). Student engagement matters: A self-determination perspective on Chinese MSW students'perceived competence after practice learning. British Journal of Social Work, 48(3), 787–807. https://doi.org/10.1093/bjsw/bcx015

Weinstein, C. E., Palmer, D., & Schulte, A. C. (1987). Learning and Study Strategies Inventory (LASSI).

Yan, Z. (2019). Self-assessment in the process of self-regulated learning and its relationship with academic achievement. Assessment & Evaluation in Higher Education, 45(2), 1–15. https://doi.org/10.1080/02602938.2019.1629390

Yan, Z., & Carless, D. (2021). Self-assessment is about more than self: the enabling role of feedback literacy. Assessment & Evaluation in Higher Education, 47(7), 1–13. Tandfonline. https://doi.org/10.1080/02602938.2021.2001431

Yusoff, M. S. B. (2019). ABC of Content Validation and Content Validity Index Calculation. Education in Medicine Journal, 11(2), 49–54. https://doi.org/10.21315/eimj2019.11.2.6

2024. Vol 4. No 4. pg 56-70. e-ISSN: 2805-4695

Zimmerman, B. J. (2000). Self-Efficacy: An Essential Motive to Learn. Contemporary Educational Psychology, 25(1), 82–91. https://doi.org/10.1006/ceps.1999.1016

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. Theory into Practice, 41(2), 64–70. https://doi.org/10.1207/s15430421tip4102_2

Zumbrunn, S., Tadlock, J., & Roberts, E. D. (2011). Encouraging self-regulated learning in the classroom: A review of the literature. Metropolitan Educational Research Consortium (MERC), Virginia Commonwealth University. http://scholarscompass.vcu.edu/merc_pubs/18

Yan, Z. (2019). Self-assessment in the process of self-regulated learning and its relationship with academic achievement. Assessment & Evaluation in Higher Education, 45(2), 1–15. https://doi.org/10.1080/02602938.2019.1629390