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Exploratory Factor Analysis of STEM's Subjective Task Value and Expectation for Success Scale

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ABSTRACT

This pilot study addresses the concerning trend of high-achieving students opting out of STEM courses, despite their capabilities and interests. Understanding the factors influencing this decision is crucial for enhancing STEM education and retention rates globally. This research is relevant as it validates the constructs of STEM subjective task value (STV) and STEM expectation for success (EFS), which are significant contributors to this phenomenon. We employed a purposive sampling approach, collecting data from 111 high-performing students enrolled in a public university in Malaysia. The study utilized Exploratory Factor Analysis (EFA) to establish reliable measures for the STV and EFS constructs, using a 10-interval scale for item responses. Data analysis was conducted with IBM SPSS version 28.0, applying the Principal Component extraction method with Varimax Rotation. We also performed Bartlett's Test of Sphericity and assessed sampling adequacy using the Kaiser-Meyer-Olkin (KMO) measure. The reliability of the retained items was tested using Cronbach's alpha. Our findings confirmed the validity and reliability of the instruments, retaining nine items for STEM subjective value and six for STEM expectation for success. This study provides a validated framework for measuring STV and EFS among high achievers in STEM, informing strategies to encourage greater enrollment in these fields.

Keywords: STEM, Exploratory factor analysis, Subjective task value, Expectation for success, STEM high achievers

INTRODUCTION

When Alexander Graham Bell invented the telephone in 1876, he sought to create a device that could transmit voice over long distances. Little did he know that over 150 years later, it would allow us to see each other while communicating. This evolution results from advancements in Science, Technology, Engineering, and Mathematics, collectively known as STEM. Such progress in STEM has created numerous job opportunities. Of 14.8 million workers in the country, Malaysia covers only 28% of the science and technical (S&T) skilled employment (Ali et al., 2021). Malaysia needs a workforce of 493,830 people in STEM-related industries by 2020 to support the government's initiatives in the New Economic Model. This means that the increase rate in STEM employment should be about 31% per year (Ministry of Education, 2014).

These examples highlight the importance of STEM education for humankind. Unfortunately, there is a significant problem with an inadequate number of students enrolling in STEM-related streams at various stages of education (Denissen et al., 2007; Mohd Shahali et al., 2019; Wong et al., 2022).

Globally, several longitudinal studies have investigated the issue of insufficient STEM students. Notable examples include the report by The National Academies of the United States entitled "Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Future" (National Academy of Science, 2007), the cooperative research project "The Relevance of Science" (ROSE) initiated in Norway (Sjoberg &

Schreiner, 2006) and not forgetting the Science and Career Aspiration (ASPIRES) project funded by the UK's Economic and Social Research Council (DeWitt et al., 2013). In Malaysia, the Educational Planning and Research Division established a committee in 1962 to strategize human resource development in line with educational progress (Phang et al., 2020), but the desired results were not achieved (Kaur et al., 2020; Shahali et al., 2017)

The current situation in Malaysia and many other nations demonstrates a widespread reduction in students pursuing STEM fields. Numerous studies have explored the reasons behind this trend, focusing on the psychological aspects of students (Arif et al., 2019; Nguyen et al., 2020). Among the psychological characteristics examined are students' expectations for success and their subjective task value in STEM. Thus, there is a need for a scientific study on how these two aspects—subjective task value and expectations for success—affect student decisions in choosing STEM as a scholarly endeavor (Anderson & Ward, 2014; Appianing & Van Eck, 2018; Eccles, 2011). The research findings can be used by other countries with similar education systems by which the students are streamed into the STEM and non-STEM tracks accordingly based on their academic performance as early as during the upper secondary level.

OBJECTIVE OF THE STUDY

This research aims to explore and determine the factor structure of an instrument adopted and adapted to measure STEM's subjective task value and expectation for success among competent STEM students. The specific objectives of the research are two-fold:

1. To determine whether the items measuring subjective task value and expectation for success are suitable and comprise an interpretable underlying factor structure.
2. To ascertain the reliability and validity of the factor structure that represents the beliefs of competent STEM students regarding their STEM subjective task value and expectation for success.

LITERATURE REVIEW

Selection of academic path

In the process of selecting an academic path, individual characteristics play a significant role (Mullet et al., 2017). Research suggests that values and expectations are potent predictors of motivation and persistence in various activities, tasks, and choices (Appianing & Van Eck, 2018). Extensive research has been conducted on the impact of subjective task value and expectation for success toward academic choice (Guo et al., 2015a; Khattab, 2015; Muenks et al., 2018). To succeed in STEM education, students must possess the requisite attitudes, including the subjective task value and expectation for success in the STEM discipline (Wiebe et al., 2018).

Research on STEM subjective task value and STEM expectation for success in an academic setting is crucial for several reasons. These two attributes have an interweaving effect in influencing students' aspirations toward STEM. It can also allow for a more personalized approach to education where educators can tailor their teaching methods, assignments, and curricula to better align with students' perceived values, making learning experiences more meaningful and effective. Research indicates that students are more likely to drop out when they perceive low value in their coursework or the overall educational experience. Academic institutions can potentially reduce dropout rates and improve student retention particularly in STEM by identifying and addressing factors contributing to low task value perceptions (Andersen & Ward, 2014).

In conclusion, research on subjective task value is essential for fostering motivation, personalizing education, improving student outcomes, promoting equity, and continuously enhancing teaching practices in academic settings. It is a foundational element in creating a supportive and effective learning environment for all students.

STEM's Subjective Task Value

Subjective task value refers to the intrinsic motives that compel students to participate in achievement-related activities (Robinson et al., 2019). Expectancy-value theory designates subjective task value as multi-layered

(Wigfield & Cambria, 2010). Individuals may assign value to a task or domain based on its level of interest or enjoyment (interest or intrinsic value), its usefulness in achieving current or future goals (utility value), or its significance to one's identity (attainment value). Conversely, cost value refers to a task's perceived disadvantages or drawbacks. Eccles et al. (1983) introduced three unique classifications of perceived cost: opportunity cost, effort cost, and psychological cost. Opportunity cost is the notion that when someone chooses to do a specific task, they give up the opportunity to engage in other activities of lower value. Effort cost is the subjective evaluation of whether the exertion needed to succeed in a task is justified. Psychological cost is the belief that there is a connection between the possibility of failing a task and experiencing intense negative feelings, such as anxiety and stress.

Eccles (2009) highlights the distinct functions performed by various forms of value in forecasting results. Different research on high school students indicates that individual values do not function as a singular notion but have diverse impacts on results. Interest value, utility value, and attainment value, which represent different levels of personal significance, exhibit clear and significant correlations with outcomes such as educational attainment, course selections, major selection, and achievement (Eccles et al., 1999; Guo et al., 2016; Guo et al., 2015a; Guo et al., 2015b; Watt et al., 2012). According to Schiefele's study, value-related attitudes significantly influence decision-making behaviors and beliefs, specifically in STEM fields, including career goals.

The results of a recent study conducted by Rosenzweig et al. (2019) demonstrated that students' academic choices were influenced by their perception of the adverse outcomes, or 'costs,' linked to completing a task. The study conducted by Wu et al. (2020) using bivariate correlation and multiple hierarchical regression analysis revealed a positive link between subjective task ratings and achievement behaviors.

STEM’s Expectation for Success

The expectation for success pertains to the student's impression of the likelihood of attaining success in a task or activity (Robinson et al., 2019). Anticipations are crucial indicators of academic results (Eccles & Wigfield, 2002). The influence of students' real triumphs and failures on their expectations of success is generally acknowledged (Wigfield et al., 2016). Extraordinary academic achievement and course enrollment are more likely to occur when students have more confidence in their cognitive ability in specific subjects, such as mathematics and science (Wigfield & Eccles, 2000).

Prior research has shown the significant impact of students' expectations on their achievements and decisions related to STEM fields, as well as their academic perseverance (Schnettler et al., 2020). Regarding the perception of expectations in STEM fields, there is a clear correlation between high school students' perceived competence in mathematics and their later participation in math courses, as well as their interest in pursuing math or STEM-related careers (Wang, 2012; Wang et al., 2013). There was a favorable correlation between college students' expectations and their choice of STEM majors (Sax et al., 2015; Wang et al., 2013). Previous studies have indicated that while greater focus has been placed on math expectation beliefs, research also demonstrates that scientific expectancy significantly influences career aspirations in STEM fields (Andersen & Ward, 2014).

While there is a good understanding of the specific connections between students' motivating beliefs and various achievements in STEM subjects, the impact of expectancy-value interactions on student outcomes is still unknown, even though it is a crucial focus of Atkinson's original model. Several research studies have neglected to incorporate these hypothesized multiplicative factors in their analyses (Nagengast et al., 2013) or have yielded inconclusive findings regarding the influence of these interaction terms on student outcomes, including many non-significant interaction effects (Wang et al., 2013). Also, it is not yet known if the interactions between the components of expectancy-value theory (EVT) lead to a compensatory effect, where one element of expectancy makes up for the value component in predicting student outcomes, or a synergistic effect, where a student's motivation is high only when both task value and expectancy are high (Guo et al., 2016).

Exploratory Factor Analysis

The researcher adapted the measuring instrument for STEM Subjective Task Value and STEM Expectation for Success construct from previous literature and modified the items to suit the current study. Factor analysis is an interdependence technique whose primary objective is to define the underlying structure among the variables in the analysis (Hair et al., 2014). The factors are latent constructs that cannot be measured directly; instead, they are represented by a group of items for their measurements. There are two main classes of factor analysis: Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). It is a technique to examine the potential structure of the data collected without making any assumptions about a specific model. In contrast, Confirmatory Factor Analysis is a method that assesses if the data gathered aligns with a pre-established model of factors and indicators.

EFA is a commonly utilized statistical technique, especially in the field of social science research. Studies indicate that employing the EFA technique yields more accurate outcomes, particularly when the research involves many quantifiable variables, which can be either endogenous or exogenous (Maccallum et al., 1999; Velicer & Fava, 1987). According to Nayak (2016), as cited by Ehido et al. (2020) EFA procedure is employed when there is ambiguity about the number of factors that may exist in a set of variables. The primary purpose of EFA is to sum up the data enclosed in many of the initial items into a smaller set of new factors with the slightest loss of details (Awang & Siddiqui, 2018; Azma Rahlin et al., 2020; Baistaman et al., 2020; Hair et al., 2014; Mahfouz et al., 2019). Furthermore, EFA clarifies the essential connection between the variables under investigation, which cannot be directly quantified but are instead shown as a collection of elements (Hair et al., 2014). Nayak & Sahoo (2015) state that EFA is employed when there is uncertainty regarding the number of factors to be included in a set of variables.

EFA is exploratory in nature, and researchers make no presumptions concerning a variable's number or nature of factors. It allows the researchers to examine the fundamental aspects of constructing a theory or model from a substantial collection of latent constructs. According to Awang (2012), the EFA procedure involves suppressing the loading factor value at a threshold of 0.60 or higher. This opinion is further supported by (Yahaya et al., 2018) and (Azma Rahlin et al., 2020) factor loading for each item should be more than 0.6 for any item to be retained.

RESEARCH METHODOLOGY

The methodology employed is essential in achieving the aim of any study. To provide a valid and reliable measurement scale for the STEM's subjective task value and STEM's expectation for success constructs, specifically within the setting of STEM high achievers (individuals who have demonstrated exemplary performance in pure sciences and mathematical subjects), this study employed a correlational research design. How a researcher designs, structures, and implements a study can affect the research findings and is an essential consideration regarding bias. Purposive sampling was selected as the sampling technique appropriate when the researcher establishes specific criteria for potential respondents.

This study employs a quantitative approach, collecting data through a self-administered online questionnaire. A detailed literature review was conducted to identify validated questionnaires that measure STEM subjective task value and STEM expectation for success, subsequently modifying the items to fit the context of this study. Participants included students from foundation studies in law and TESL enrolled in a public university in Selangor, Malaysia. The students achieved at least one A, and three B grades in STEM-related subjects—Additional Mathematics, Biology, Chemistry, and Physics—during their SPM, a prerequisite for higher education applications. Despite their strong performance in these subjects, the students opted for foundation studies in TESL or Law.

The sample size for this study was determined based on recommendations from previous research, which suggest that a minimum sample size of 100 respondents is adequate for conducting EFA to ensure the stability and reliability of the factor structure. With 111 students responding to the online questionnaire, this sample size meets the threshold necessary for meaningful statistical analysis and provides sufficient power to detect significant relationships. The online questionnaire link was disseminated through several channels accessible to potential respondents. The procedures for selecting respondents were explicitly outlined to mitigate potential confusion among students aspiring to participate in the study. Data was collected via Google Forms, and the responses were analyzed using IBM SPSS Statistics version 28.

EFA was applied to data analysis to identify significant items for the proposed model. This procedure involved rotated component analysis to clarify the factor structure and ensure that the items accurately represented the constructs of STEM subjective task value and expectation for success. The analysis included assessing the adequacy of the sample using the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity to confirm the appropriateness of EFA.

Research instrument

STEM's subjective task value scale was measured using a 9-item measure established by (Appianing & Van Eck, 2018). A sample item is 'I find STEM-related jobs very interesting.' Some of the items in the original scale have negative wording. Thus, all such items were modified to positive phrasing. For instance, the item 'I dislike STEM courses' was changed to 'I like STEM courses. Conversely, STEM's expectation for success was assessed using a 6-item measure developed by Appianing & Van Eck (2018), with a sample item being, 'I think I will succeed in a STEM field.' Similarly, the negative wording item such as 'I don't think I will succeed in a STEM field' was revised to 'I think I can succeed in a STEM field'. The original questionnaire, which used a 5-point interval scale, was transformed into a 10-point interval scale ranging from 1 = Strongly Disagree to 10 = Strongly Agree. Awang et al. (2016) support using a 10-point interval scale, asserting that it provides greater precision in measurement due to its broader range of options and enhanced level of independence.

Pre-test stage and pilot study

The adapted questionnaire went through the pre-testing stage before distribution for the pilot study. According to (Azma Rahlin et al., 2020), conducting both a pre-test and pilot test is essential to validate the modified instrument, especially when the original instrument was developed for a different cultural and industrial context. Once the modification process was concluded, the questionnaire content and face validity were reviewed by five experts: two professors and three senior lecturers. This ensures that the measures are suitable and understandable for the intended purpose. One of the professors, a statistician, assessed the criterion validity and confirmed that the scales used for data management were suitable for the statistical analysis. The experts suggested that some questions be shortened and reworded to avoid double-barreled questions. The questionnaire was revised accordingly based on their feedback, and the researcher pre-tested it with 30 randomly selected students to evaluate the Cronbach alpha value.

After making all necessary adjustments according to the pre-test results, the researcher carried out the pilot study by distributing the questionnaire to potential respondents. Google Forms was utilized to collect responses. According to Azma Rahlin et al. (2020), EFA requires a minimum of 100 responses. After five days, the link to the online questionnaire was closed once the minimum number of respondents was reached.

RESULT AND DISCUSSION

Data obtained from Google Forms was first transferred to Microsoft Excel and then imported into SPSS. The researcher used SPSS to conduct EFA by utilizing principal component analysis with varimax rotation technique on a sample of 111 datasets. This analysis aimed to assess and refine the scale items, and to identify which items should be grouped within the same components.

Tables 1 and 2 present the descriptive statistics for each item measuring STEM Subjective Task Value and Expectation for Success. The standard deviation was calculated to understand the data distribution based on error and variance values, which helped to identify the mean (Alkhawaja et al., 2020). For the STEM Subjective Task Value (STV) scale, the mean values for each item ranged from 4.81 to 6.44, with standard deviation values between 2.251 and 2.559. In contrast, the mean values for each item on the Expectation for Success (EFS) scale ranged from 5.17 to 5.67, while the standard deviation values were between 2.351 and 2.647.

Table 1 Mean and Standard Deviation for Itemsmeasuring Subjective Task Value

Descriptive Statistics			
Item	Statement	Mean	Std. Deviation
STV1	I find STEM-related jobs very interesting	6.64	2.339

STV2	I would take a course in STEM even if it were not required	5.31	2.551
STV3	STEM is an important field for me	5.57	2.251
STV4	I like STEM course	5.68	2.559
STV5	STEM is a good college major for me	5.21	2.472
STV6	Working in a STEM field would help me achieve my professional aspirations	4.81	2.448
STV7	I feel I would have something to be proud of as a STEM professional	5.76	2.483
STV8	Working in a STEM field would not be a waste of my time	5.80	2.423
STV9	Studying STEM is useful for getting a good job in the future	6.55	2.251

Table 2 Mean and Standard Deviation for Items Measuring Expectation for Success

Descriptive statistics			
Item	Statement	Mean	Std. Deviation
EFS1	I think I will succeed in a STEM field	5.43	2.452
EFS2	I think I can make an impact if I take on a STEM-related job	5.17	2.351
EFS3	I would certainly feel useful in a STEM-related job	5.44	2.381
EFS4	I would be able to succeed in a STEM field as well as most other people	5.52	2.327
EFS5	I feel I have a number of good qualities to be successful in STEM field	5.59	2.414
EFS6	I think I would be a good scientist/ engineer/ mathematician one day if I remain in the STEM stream	5.67	2.647

Kaiser-Meyer-Olkin (KMO) and Bartlett’s Test of Spehericity

To assess the adequacy of the sampling, Kaiser-Meyer-Olkin (KMO) and Bartlett’s tests were conducted. (Hair et al., 2008) state that a KMO value exceeding 0.50 is necessary to ensure the purity of measurement items. In this study, only items with factor loadings above 0.60 were retained for further analysis. The KMO value for the STEM Subjective Task Value (STV) scale is 0.924 (Table 3), while the KMO value for the Expectation for Success (EFS) scale is 0.891 (Table 4). Both values are considered exceptional, as they exceed the recommended threshold of 0.6.

Moreover, for factor analysis to be deemed acceptable, Bartlett's Test of Sphericity must yield a p-value below 0.05. The significant value of Bartlett's Test for both scales is < 0.001, meeting the predetermined significance level of less than 0.05 (Awang, 2012; Awang & Siddiqui, 2018). Thus, Bartlett’s Test of Sphericity is significant (p-value < 0.05), and the sampling adequacy as indicated by Kaiser–Meyer–Olkin (KMO) is excellen, having surpassed the required value of 0.50. Consequently, the available data are sufficient to proceed with the data reduction phase in EFA. This phase involves reducing the number of components to a manageable level before conducting further analysis

Table 3 Kmo and Bartlett’s Test for Subjective Task Value

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.924
Bartlett's Test of Sphericity	Approx. Chi-Square	758.109
	df	36
	Sig.	<.001

Table 4 Kmo and Bartlett’s Test for Expectation for Success

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.891
Bartlett's Test of Sphericity	Approx. Chi-Square	753.063
	df	15
	Sig.	<.001

Scree Plot

The scree plot is another method for determining the total number of components in the STEM Subjective Task Value (STV) and STEM Expectation for Success (EFS) constructs. As illustrated in Figure 1 and Figure 2, the scree plot indicates that one factor has been identified for each construct.

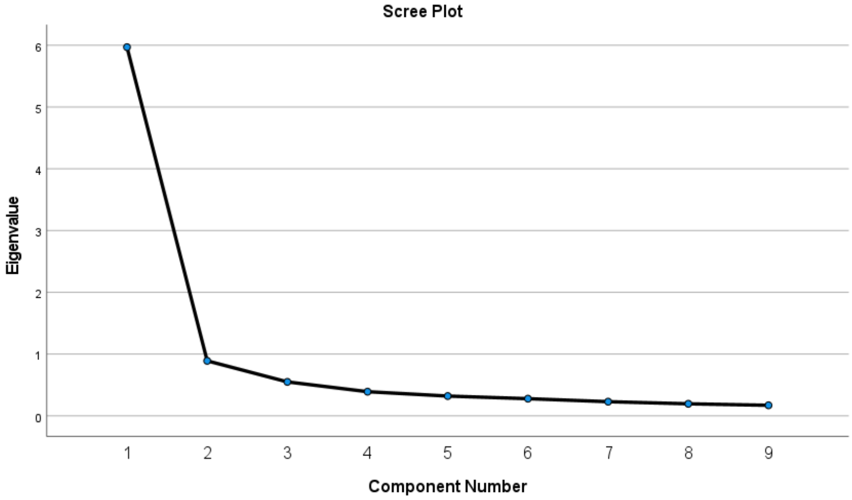

Fig 1 Scree plot for subjective task value

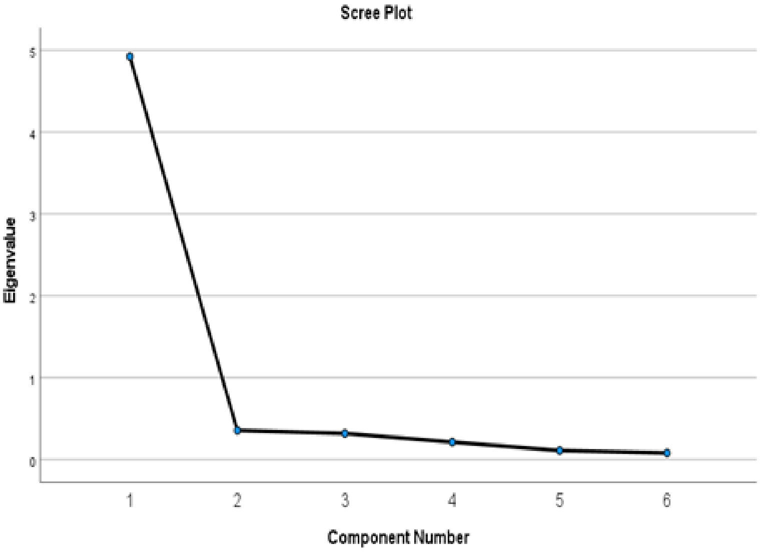

Fig 2 Scree plot for expectation for success

Component Matrix and Total Variance Explained

The results presented in Table 5 indicate that the EFA identified one component for the Expectation for Task

Value (ETV) scale, with an Eigenvalue greater than 1.0. The Eigenvalue is 5.970, and this single component accounts for 66.33% of the total variance explained

Table 5 The Component and Total Variance Explained for Subjective Task Value

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.970	66.332	66.332	5.970	66.332	66.332
2	.891	9.901	76.234			
3	.550	6.115	82.348			
4	.392	4.352	86.700			
5	.321	3.567	90.268			
6	.279	3.096	93.363			
7	.230	2.557	95.920			
8	.196	2.174	98.094			
9	.172	1.906	100.000			
Extraction Method: Principal Component Analysis.						

Similarly, the EFA for the Expectation for Value (ETV) scale identified a single component, as indicated by an Eigenvalue greater than 1.0 (Table 6). The Eigenvalue is 4.922, and this component accounts for 82.40% of the total variance explained.

Table 6 The Component and Total Variance Explained for Expectation for Success

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.922	82.040	82.040	4.922	82.040	82.040
2	.355	5.919	87.959			
3	.319	5.318	93.277			
4	.213	3.550	96.827			
5	.110	1.836	98.663			
6	.080	1.337	100.000			
Extraction Method: Principal Component Analysis.						

Following Awang (2012), the rotated component matrix was investigated, and items with a factor loading greater than 0.6 were selected for further analysis. Tables 7 and 8 display the single dimensions or components for each identified construct and their corresponding items resulting from the EFA. To be retained, each item must have a factor loading greater than 0.6, indicating its effectiveness in measuring the specific construct (Yahaya et al., 2018).

Table 7 Factor Loading for The Final Items for The Subjective Task Value Construct

Item	Item label	Item statement	Component 1
1	SVT 1	STEM is an important field for me	.874
2	SVT 2	Working in a STEM field would help me achieve my professional aspirations	.871

3	SVT 3	STEM is a good college major for me	.867
4	SVT 4	I feel I would have something to be proud of as a STEM professional	.856
5	SVT 5	I would take a course in STEM even if it were not required	.815
6	SVT 6	I like STEM course	.808
7	SVT 7	Working in a STEM field would not not be a waste of time	.801
8	SVT 8	I find STEM-related jobs very interesting	.726
9	SVT 9	Studying STEM is useful for getting a good job in the future	.692
Extraction Method: Principal Component Analysis. a. 1 components extracted.			

Table 8 Factor Loading for The Final Items for The Expectation for Success Construct

Item	Item label	Item statement	Component 1
1	EFS 1	I would be able to succeed in a STEM field as well as most other people	.950
2	EFS 2	I think I can make an impact if I take on a STEM-related job	.948
3	EFS 3	I would certainly feel useful in a STEM-related job	.907
4	EFS 4	I feel I have a number of good qualities to be successful in STEM field	.886
5	EFS 5	I think I will succeed in a STEM field	.875
6	EFS 6	I think I would be a good scientist/engineer/mathematician one day if I remain in the STEM stream	.864
Extraction Method: Principal Component Analysis. a. 1 components extracted.			

Internal Reliability

By calculating the coefficient alpha, one can evaluate the reliability of a scale. The traditional Cronbach's alpha method is commonly used to assess the reliability of the items within a specific scale. According to (Sekaran & Bougie, 2010), a desirable coefficient alpha is greater than 0.70. Cronbach's alpha is a constant coefficient indicating the proportional relationships among item sets (Sekaran & Bougie, 2010). A model is considered weak if its Cronbach’s alpha value falls below 0.70. As shown in Table 9, both scales exhibit high internal reliability, with Cronbach’s alpha values for the SVT and EFS scales being 0.936 and 0.955, respectively.

Table 9 Internal Reliability

Construct	N of Items	Cronbach's Alpha
Subjective Task Value	9	0.936
Expectation For Success	6	0.955

Discussion

Choosing an academic pathway can be challenging, especially for high-achieving students who often have a wide range of interests and options. They must conduct a self-assessment that encompasses their interests, passions, strengths, weaknesses, values and goals. Additionally, they need to explore various fields of study and consider their ability to adapt to future challenges. Consequently, students often seek advice from multiple sources, including parents, teachers and peers.

The results align with those of Appianing & Van Eck (2018) in which only a single component was identified for each construct. All items were retained since their factor loadings exceeded 0.6, as recommended by Awang (2012). This indicates that the scale for both STEM's subjective task value and expectation for success demonstrated good reliability and validity, making them suitable for high-achieving students. The content validity of the scales was established by through the professional judgement of five experts on the nine items of STEM subjective task value and six items pertaining to STEM expectation for success, respectively. The EFA was subsequently conducted to identify the underlying factor structure and confirm the scale's construct validity. The extracted factors' internal consistency was also assessed using Cronbach's alpha to determine the scale's reliability.

This study aimed to develop a scale that measures STEM subjective task value and expectation for success among high-achievers in Malaysia. The analysis revealed that a single component defines both constructs, contributing to the limited literature on this topic, particularly concerning high-achieving students. These findings highlight the importance of further research to inform policy implementation, especially as the country requires more STEM graduates to meet the demands of STEM-related careers (Ali et al, 2021; Ministry of Education, 2014).

This study makes a significant contribution to the assessment of STEM subjective task value and expectations for success, specifically targeting high-achieving STEM students within Malaysian education. The EFA results revealed a structure that identifies a single dimension for both the STEM subjective task value and the STEM expectation for success constructs. Each construct can be measured using the 9-item and 6-item scales developed in this study. The reliability measures for both constructs demonstrated high Cronbach's alpha values, meeting the criteria of significant Bartlett's Test results, acceptable KMO values (>0.6), and factor loadings exceeding the minimum threshold of 0.6. This indicates that the items are relevant and applicable to this study.

The validated scale is useful for STEM stakeholders as it enhances their understanding of how STEM subjective task value and expectation for success influence students' academic choices. This scale can be used to investigate how these factors contribute to potential STEM undergraduates' decision to exit the STEM pipeline. It is the responsibility of relevant government authorities to achieve the desired number of STEM graduates and professionals in Malaysia. To further validate the current factor structure and its contributions, an extended study employing confirmatory factor analysis is recommended, aiming to develop a more comprehensive scale for STEM subjective task value and expectation for success.

CONCLUSIONS

This work contributes a significant survey instrument to the existing literature, facilitating the measurement of STEM subjective task value and expectation for success. To increase the number of STEM students at higher education levels, this study aims to investigate and assess the reliability of these constructs among STEM students in Malaysia, focusing specifically on high-achieving individuals in STEM courses. The implications of this study could inform future research on the structural model, providing valuable insights for applied researchers in STEM education.

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