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Investigating the Validity and Reliability of a Scientific Imagination Test for Tenth graders

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Abstract

This research was conducted to evaluate the reliability and validity of the Scientific Imagination Test (SIT) using the Rasch Measurement Model. SIT is a set of questions developed by the researchers based on the Integrated Engineering Design Process with Scientific Imagination Model. SIT was developed to evaluate the scientific imagination constructs among the tenth graders. SIT is a test consisted of two main open-ended subjective questions and 14 sub-items. Students' scientific imagination was assessed based on the three stages of scientific imagination namely initiation, dynamic adjustment and virtual implementation; which consisted of four basic constructs respectively: brainstorming, association, transformation and elaboration, and conceptualization/organization/formation. The sample consisted of 65 Tenth Grade students aged 16 years old from two secondary schools in a district in Sabah, Malaysia. Overall, the findings showed that SIT has a very high reliability with Cronbach's alpha (KR-20) value of 0.92. The findings also showed that SIT has excellent item reliability of 0.97 with separation value of 5.30. SIT also has a very good respondent reliability of 0.92 with separation value of 3.40. Meanwhile, the assessment on the item fit, respondent fit and unidimensionality established the construct validity of the SIT instrument. In conclusion, the findings indicate that the SIT instrument is a reliable and valid instrument for measuring the scientific imagination of tenth graders.

Keywords:
Engineering design process
Reliability and validity
Rasch measurement model
Scientific imagination.

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1. Introduction

Imagination, creativity and innovation are concepts that build upon each other; where imagination from the arts or sciences is engaged through creativity and turns into innovative ideas. Through the power of imagination, individuals can discover new ideas, images or sensations through a combination of their experiences. In science, imagination is seen as a creative activity in line with scientific concepts. According to Wang, Ho, and Cheng (2015) scientific imagination is a mental activity that involves generation of new ideas that are consistent with scientific principles and related to the everyday life experiences. Given the importance of imagination in the pursuit of new ideas for problem solving and creation, school science curriculum begins to pay special attention to the scientific imagination. According to McCormack (2010) science education today is an excellent platform to emphasize imagination and innovation. Emphasis on the imagination in science education (for example, scientific research and student-centered innovation) benefits the curriculum as a whole by expanding the science concept of students (Wang et al., 2015).

Researches related to the scientific imagination have been actively conducted by researchers in Taiwan (Cheng & Chuang, 2018; Ho, Wang, & Cheng, 2013; Wang et al., 2015; Wang., Ho, Wu, & Cheng, 2014) and Korea (Mun, Mun, & Kim, 2015). However, these researches focused on the scientific imagination of primary school students. For example, Wang et al. (2015) developed an instrument known as the Scientific Imagination Test-Verbal (SIT-Verbal) for assessing primary school students' level of scientific imagination. Vygotsky (1990); Vygotsky. (1994) concluded that individuals' creative imagination develope with age, and imagination and abstract thinking are completely integrated with each other in adulthood. Therefore, there is a need to develop a test that can assess the secondary school students' scientific imagination. In the Malaysian context, the assessment on the scientific imagination among secondary school students was conducted previously by Siew (2017) at a rural school in a district in Sabah. The scientific imagination test used in this study was a written test and was administered as a pre-test and post-test during the 10-hour STEM outreach program. However, the instrument was administered over a short period of study and only focused on the El Niño phenomenon that occurred at the study site. Thus, a generic instrument needs to be constructed that can be used for different contexts. This study thus aims to fill the research gaps by developing a test to assess the scientific imagination of secondary school students.

2. Theoretical Background

Wang et al. (2015) refers scientific imagination as the student's individual mental activities to generate new ideas through three processes classified as initiation, dynamic adjustment, and virtual implementation. There are several constructs in each stage of scientific imagination as shown in Table 1.

Table-1. The Stages and Constructs of Scientific Imagination.

Stages	Construct
Initiation	Brainstorming-Problem (BP)
	Association- Problem (AP)
Dynamic Adjustment	Brainstorming- Solution (BS)
	Association- Solution (AS)
	Transformation (TF)/ Elaboration (EB)
Virtual Implementation	Conceptualization/ Organization/ Formation (COF)

Source: Wang et al. (2015).

At the initiation stage, students identify problems and explore how much the problem is related to their daily lives through brainstorming. At the stage of dynamic adjustment, students work on original ideas and formulate new ideas to solve problems. At this stage, the transformation and elaboration components are involved in giving meaning to the ideas in order to formulate better new ideas. At this stage too, students create an initial sketch of the prototype that describes the physical features and functions of the creation. Students need to explain specific ideas about physical features and functions in the creation. The virtual implementation stage involves the students to formulate their ideas through sketching a prototype, to ensure that their creation of prototype can be realized in the future. Students need to give details to the sketches by describing the selected materials, installation techniques for the parts, and ways of designing the final sketch from the initial sketch.

In this research, the scientific imagination process proposed by Wang et al. (2015) was integrated with the engineering design process as a model in developing the test items in scientific imagination test. The initial engineering design process proposed by the Massachusetts Department of Education (2006) consists of eight steps; (i) identifying the problems, (ii) investigating the problems, (iii) suggesting possible solutions, (iv) selecting the best solution, (v) developing prototypes, (vi) testing and evaluating solutions, (vii) communicating the solution; and (viii) redesigning. The engineering design process employed in the development of SIT test Figure 1 removed the steps numbered vi, and viii proposed by the Massachusetts Department of Education (2006). This modification was made to ensure that students could produce a detailed sketch of the prototype by emphasizing on the development of students' scientific imagination. Figure 1 shows the integrated model between the engineering design process with scientific imagination.

The advantages of the proposed integrated engineering design process with imagination model is that it involves brainstorming and association in identifying problems and solutions that drive students to encounter the process of initiation. It allows students to become aware of the many possible solutions as they engage in sketching. The process of finding the optimal solution by designing a prototype requires participants to engage in transformation and elaboration. Students are required to communicate their solutions to facilitators and peers on how to formalize the idea to be realized in future, thus driving them into the conceptualization, organization, and formation. By going through the six stages in this process, learners are intended to develop scientific imagination while carrying out the activities.

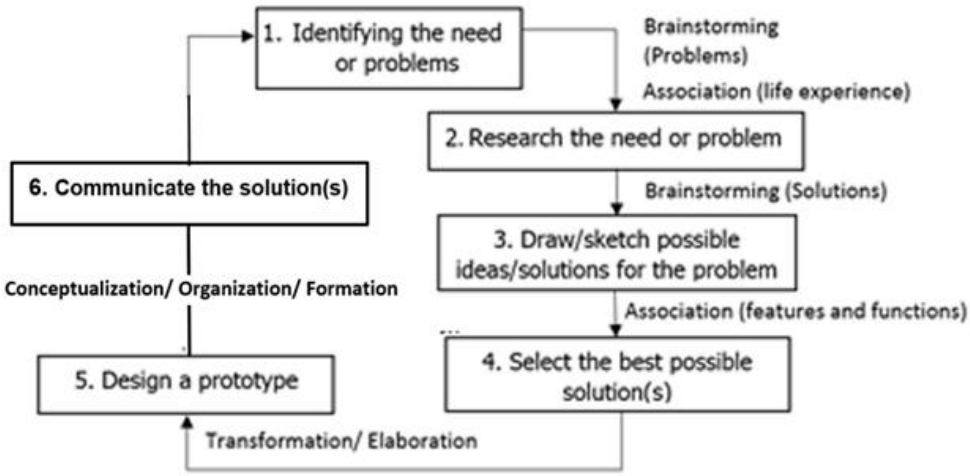

Figure-1. An Integration model between the engineering design process and scientific imagination.

There are four stages in the integration of engineering design process with scientific imagination model; (1) Initiation, (2) Dynamic adjustments, (3) Virtual implementation, (4) Prototype creation. The steps at each stage are described below:

(i) Initiation Stage
Step 1: Brainstorming - Identify the needs or problems
Students are involved to identify as many problems as possible in the given situation.
Step 2: Association - Investigate the association between the needs or problems with daily life.
Students relate the identified problems to everyday life.

(ii) Dynamic Adjustment Stage
Step 3: Brainstorming - Present the expected solution
Students use imagination to come up with as many solutions as possible to the problems
Step 4: Association - Choose the most appropriate solution
Students choose the most appropriate solution and associate with the physical features and functions to the solution.
Step 5: Transformation - Design a sketch of the prototype
Students transform their creative ideas into sketches of the prototype
Step 6: Elaboration - Explain the solution
Students explain the physical features and functions of their creation using the sketches they produced.

(iii) Virtual Implementation Stage
Step 7: Conceptualization/ Organization/ Formation - Reorganization of prototype sketch.
Students reorganize and improve the existing sketches by including the details on the selected material, techniques for assembling parts to produce more meaningful prototypes.

(iv) Prototype Creation Stage
Step 8: Prototype creation, testing and evaluation
Students build, test and evaluate prototypes based on the sketches of their creations.

3. The Development of Scientific Imagination Test

The Scientific Imagination Test (SIT) was developed based on an integrated engineering design process with scientific imagination model to assess the four basic components of the scientific imagination process namely brainstorming, association, transformation/elaboration, and conceptualization/organization/formation. There were two main questions in SIT: Question 1 and Question 2. To assess these four components in depth, the researchers had broken down each of the questions into 7 items. The distribution of the items is shown in Table 2.

Question 1 was about the green technology city. Item 1(a) required the students to identify problems related to the urban pollution (Brainstorming-problem), while item 1(b) required the students to investigate the problems caused by the urban pollution (Association-problem). Item 1(c) required the students to propose solutions to the problems (Brainstorming-solution) while item 1(d) required students to choose the most appropriate solution to the problems (Association-solution). Item 1(e) required the students to design the solution in form of a prototype (Transformation), and item 1(f) required the student to describe the solution via sketching (Elaboration). Lastly, item 1(g) required the students to draw a detailed sketch for the prototype (Conceptualization/Organization/ Formation).

Question 2 was regarding the home energy management. Similar to the Question 1, the scientific imagination components were evaluated through 7 items. Item 2(a) required the students to identify problems related to energy management (Brainstorming-problem) and item 2 (b) required the students to investigate the problems related to the home energy management (Association-problem). Item 2 (c) required the students to suggest solutions for problems of home energy management (Brainstorming-solution) and item 2 (d) required the students to choose the most appropriate solution for the problems of home energy management (Association-solution). Item 2 (e) required the students to design a solution (Transformation) while item 2 (f) requires the students to describe the solution using a sketch (Explanation). Lastly, item 2 (g) required the students to draw a detailed sketch for the prototype (Conceptualization/Organization/ Formation).

Table-2. Distribution of items in scientific imagination test.

Stages of Scientific Imagination	Construct	Number of Test Items	Numbering of Test Items
Initiation	Brainstorming-Problem (BP)	2	1(a), 2(a)
	Association-Problem (AP)	2	1(b), 2(b)
Dynamic Adjustment	Brainstorming-Solution (AS)	2	1(c), 2(c)
	Association-Solution (AS)	2	1 (d), 2 (d)
	Transformation (TF)	2	1 (e), 2 (e)
	Elaboration (EB)	2	1 (f), 2 (f)
Virtual Implementation	Conceptualization/ Organization/ Formation (COF)	2	1 (g), 2 (g)

3.1. Scoring Procedures

The scoring rubric for the SIT instrument was adapted from Wang et al. (2015) and the Scientific Imagination Test by Siew (2017). This rubric was adapted to fit the engineering design process with scientific imagination model and was used to score students' responses in the SIT instrument. There are seven components of the engineering design process with scientific imagination model that was scored for each question in the SIT test. Students' scores were given based on the level of answers given. There are four levels of students' responses and each level gives specific scores which are level 1 (0 mark), level 2 (1 mark), level 3 (2 mark) and level 4 (3 mark). Level 1 is classified as a weak response, level 2 is satisfactory, level 3 is good and level 4 is excellent. Table 3 showed an example of the rubric used for scoring students' level of scientific imagination. The rubric had been reviewed carefully by the panel of experts.

Table-3. An example of the scoring rubric for the scientific imagination test.

Construct	Score	Explanation
1.1.Brainstorming	0	Students cannot identify the problem raised by the situation in the question
(Problem)	1	Students can identify 1-3 problems raised by the situation in the question
	2	Students can identify 4-5 problems raised by the situation in the question
	3	Students can identify more than 5 problems raised by the situation in the question
1.2 Association	0	Students cannot determine problems associated to their experiences in daily life.
(Problem)	1	Students can determine 1 problem associated to their experiences in daily life.
	2	Students can identify 2 problems and stated at least 1 problem directly associated to the pollution/greenhouse effect/environmental sustainability/health based on their experiences in daily life.
	3	Students can identify at least 3 problems and stated three problems directly associated to the pollution/greenhouse effect/environmental sustainability/health based on their experiences in daily life.

3.2. Rasch Measurement Model

According to Boone (2015), Rasch Measurement Model (RMM) is a psychometric method that can enhance the accuracy and monitor the quality of the instruments, as well as to measure the performance of the respondents. Meanwhile, Deane, Nomme, Jeffery, Pollock, and Birol (2016) stated that RMM is a type of a probabilistic model that can assess the ability of person and the difficulty of the items in the same scale. In RMM, the reliability of an instrument can be assessed in terms of respondent and item reliability, item and respondent separation, and Cronbach's alpha value. Meanwhile, validity of the instruments can be established through the item fit, respondent fit, and unidimensionality. Thus, based these aforementioned key concepts, RMM was used in this research to assess the reliability and validity of the SIT instrument.

3.3. Research Purpose and Objectives

In order to determine the suitability of the developed Scientific Imagination Test (SIT), the reliability and validity of the instrument needs to be carried out. Thus, the purpose this research was to evaluate the reliability and validity of the Scientific Imagination Test (SIT) instrument using Rasch Measurement Model.

Specifically, the objectives of this research were to: -

1. Assess the reliability of SIT instrument using Rasch Measurement Model.
2. Assess the validity of the SIT instrument using Rasch Measurement Model.

3.4. Research Questions

Based on the objectives of the research, there were two main questions guiding this research: -

1. What are the reliability values for the SIT instrument in terms of respondent reliability and separation, item reliability and separation, and Cronbach's Alpha (KR-20)?
2. What is the validity of the SIT instrument in terms of item fit, respondent fit, and unidimensionality?

4. Administration of Test

The scientific imagination test (SIT) was administered in a pilot study to a sample of 65 Tenth Grade science stream students who studied in two secondary schools in a district in Sabah, Malaysia. According to Johanson and Brooks (2010) the suggested minimum number of sample of a pilot study for a scale development is 30 samples. The sample comprised of 26 boys and 39 girls aged 16 years old. Prior to administration of SIT, six experts from the fields of creativity, science education, engineering education and green technology were invited to review the content of the items which were based on the integrated engineering design process with scientific imagination model. The items were improved according to the recommendations of these experts.

5. Data Analysis

The data obtained from the SIT instrument were analyzed using WINSTEPS software version 3.73. Since all of the items have the same rating scale structure and the data were in the form of polytomous data, the Rasch Polytomous Model (Rating Scale Model) was employed. There were four possible answers/responses in all of the items measuring the components of scientific imagination in SIT instrument, and these responses were classified according to the level of scientific imagination, where "0" for Level 1, "1" for Level 2, "2" for Level 3, and "3" for Level 4. According to Sumintono and Widhiarso (2015) there are three statistics that can be used to assess the reliability in RMM which are Cronbach's alpha (KR-20), item and respondent reliability, and item and respondent separation as shown Table 4.

Table-4. Reliability in RMM.

Statistics	Index	Interpretation
Cronbach's Alpha (KR-20)	<0.5	Low
	0.5 – 0.6	Moderate
	0.6 – 0.7	Good
	0.7 – 0.8	High
	>0.8	Very High
Item and Respondent Reliability	<0.67	Low
	0.67 – 0.80	Sufficient
	0.81 – 0.90	Good
	0.91 – 0.94	Very Good
	>0.94	Excellent
Item and Respondent Separation		High separation value indicates that the instrument has a good quality since it can identify the group of item and respondent.

Source: Sumintono and Widhiarso (2015).

The validity of SIT instrument was assessed through the item fit analysis. According to Olsen (2003) the logit generated from RMM can provide information to respondents' ability to respond to the items based on the difficulty of the item. Meanwhile, Sumintono and Widhiarso (2015) stated that the analysis from item fit helps researchers to ascertain whether the item is operating normally in the proposed measurement. According to Boone., Staver, and Yale (2014) and Bond and Fox (2015) there are three statistics that can be used to assess the validity in RMM which are Outfit Mean-square (MNSQ), Outfit Standardized (ZSTD), and Point Measure Correlation (PTMEA-CORR) as shown in Table 5. Outfit MNSQ evaluates the suitability of items in measuring validity, PTMEA-CORR evaluates the extent to which the construction of constructs has been achieved, and ZSTD evaluates whether the data fits the model (Bond. & Fox, 2007). Sumintono and Widhiarso (2015) stated that any item that fails to meet these three statistics criteria Table 5 needs to be revised or improved in order to ensure the suitability and quality of the items in the instrument.

Table-5. Statistics and fit indices for item fit.

Statistics	Fit Indices
Outfit MNSQ	0.50 – 1.50
Outfit ZSTD.	-2.00 – 2.00
PTMEA-CORR	0.40 – 0.85

Source: Boone. et al. (2014).

Other than that, RMM can also provide the information on the respondent fit. According to Boone (2015) RMM is able to identify the respondent fit based on the uncommon response patterns. Usually, the uncommon response patterns detected by RMM indicate that the students may have cheated, or were careless in answering the items. There are three statistics can be used to assess respondents fit, which are value of 'MEASURE', Outfit MNSQ, and Outfit ZSTD (Edwards & Alcock, 2010; Nevin et al., 2015). According to Nevin et al. (2015) a high ZSTD Outfit value (> 2.0) paired with a high MEASURE value indicates that a high ability student may respond to the 'easy' items incorrectly. Meanwhile, high ZSTD Outfit values (> 2.0) paired with a low MEASURE value indicates that a low ability student may respond to the 'difficult' items correctly but incorrectly to the other items.

Besides that, Sumintono and Widhiarso (2015) asserted that unidimensionality of an instrument is also important to be assessed in order to determine whether the instrument measures what it should be measured. RMM uses the Principal Component Analysis (PCA) to measure how well the instrument measures what it should be measured. According to Sumintono and Widhiarso (2015) unidimensionality can be assessed based on the 'raw variance explained by measures' value in PCA, where value higher than 20% is acceptable, higher than 40% is good, and higher than 60% is excellent. Meanwhile, the value for 'raw variance unexplained by measures' should not exceed 15%.

6. Results of Research

6.1. Reliability and Separation Value for Item and Respondent

Table 6 shows the reliability and separation values for item and respondent. Based on the analysis from RMM, the value for respondent reliability was 0.92 with a separation value of 3.40, while the value for item reliability was 0.97 with item separation value of 5.30. The value for Cronbach's alpha (KR-20) value was 0.92. According to Sumintono and Widhiarso (2015) these findings imply several matters, which are the SIT instrument has a very good respondent reliability, excellent item reliability, and has a very high internal consistency. Meanwhile, the values for the respondent and item separation were interpreted as good and satisfactory, and this is supported by Linacre (2003) who stated that a good separation value for item difficulty is appropriate if the respondent separation value is higher than 2.00.

Table-6. The value for person reliability, item reliability, person separation, item separation and cronbach's alpha (kr-20) value of the sit instrument.

Statistic	Value	Interpretation
Cronbach's alpha (KR-20)	0.92	Very high
Respondents Reliability	0.92	Very good
Item Reliability	0.97	Excellent
Respondent Separation	3.40	Good
Item Separation	5.30	Good

Table-7. Misfit order of items in scientific imagination test.

Item	MEASURE	*Outfit* MNSQ	*Outfit* ZSTD	PTMEA-CORR
		(0.50-1.50)	(-2.0-2.0)	(0.40-0.85)
2(g)COF	2.12	1.34	0.70	0.45
1(b)AP	-1.68	1.34	0.90	0.63
1(c)BS	0.23	1.27	1.20	0.69
2(a)BP	-3.34	1.25	0.70	0.61
2(f)EB	1.59	1.03	0.20	0.70
2(b)AP	-1.26	0.93	-0.20	0.73
1(g)COF	2.11	0.93	-0.20	0.72
2(c)BS	0.07	0.86	-0.60	0.80
2(e)TF	1.14	0.79	-1.10	0.78
1(f)EB	1.00	0.71	-1.40	0.79
1(e)TF	0.83	0.74	-1.60	0.82
1(a)BP	-3.53	0.39	-0.70	0.55
1(d)AS	0.17	0.74	-1.30	0.81
2(d)AS	0.53	0.72	-1.00	0.78

6.2. Item Fit

Table 7 shows the misfit order of items based on the value of Outfit MNSQ, Outfit ZSTD and PTMEA-CORR. Overall, the analysis from RMM found that all of the items met all of the three criteria proposed by Boone. et al. (2014). According to Sumintono and Widhiarso (2015), items that meet at least one of the criteria must be retained. Meanwhile, according to Aziz, Jusoh, Omar, Amlus, and Salleh (2014) an item is considered to be misfit if the item does not meet all of the three statistics criteria. Thus, all of the items in the SIT instrument were retained.

7. Respondent Fit

Item reliability can have a negative effect as a result from the uncommon and bad response from the misfit respondent. According to Abdul Aziz, Masodi, and Zaharim (2017) responses that caused distortion in the measurement should be removed since the data from these respondents can be categorized as unreliable. Based on the RMM analysis, all respondents (students) had the Outfit ZSTD value within the acceptable range (from -2.0 to +2.0). This implied that all of the items were suitable to be used for the research sample.

8. Unidimensionality

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TABLE 23.0 Scientific Imagination Test            ZOU952WS.TXT Aug 29 13:44 2019
INPUT: 65 Persons  14 Items  MEASURED: 65 Persons  14 Items  46 CATS       1.0.0
--------------------------------------------------------------------------------

STANDARDIZED RESIDUAL VARIANCE SCREE PLOT
Table of STANDARDIZED RESIDUAL variance (in Eigenvalue units)
                                         Empirical       Modeled
Total variance in observations     =        454.9 100.0%         100.0%
Variance explained by measures     =        440.9  96.9%          96.7%
Unexplained variance (total)       =         14.0   3.1% 100.0%    3.3%
Unexplned variance in 1st contrast =          3.2    .7%  23.1%
Unexplned variance in 2nd contrast =          2.0    .4%  14.1%
Unexplned variance in 3rd contrast =          1.7    .4%  12.2%
Unexplned variance in 4th contrast =          1.5    .3%  10.9%
Unexplned variance in 5th contrast =          1.1    .2%   7.7%
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Figure-2. Principal component analysis for the scientific imagination test.

Figure 2 showed the PCA for the SIT instrument in the RMM analysis. The value for the 'raw variance explained by measures' was 96.9%, indicates that the SIT instrument has "excellent" unidimensionality, that is, it really measures the components of scientific imagination. In addition, the value for the 'unexplained variance' from the first to the fifth contrast is fewer than 5%, which place within the ideal range of less than 15%.

8. Discussion

Overall, the analysis from RMM indicates that the SIT instrument had a very high value for Cronbach's alpha (KR-20) (0.92), very good respondent reliability (0.92), and excellent item reliability (0.97). According to Oon, Spencer, and Kam (2016) any reliability with value closed to 1 is considered to be internally consistent. Thus, this suggests that the SIT instrument is highly reliable and the items are supposedly measuring the tenth graders' scientific imagination as required. In terms of separation value, this research discovered that the value for both item and respondent separation exceeds 2.00 as suggested by Fisher (2007). This indicates that the SIT instrument has large item dispersion (Klooster, Taal, & Van De Laar, 2008) and the higher value of item separation allows the item to be separated by more than four strata and thus can assess the ability of scientific imagination for all levels of students. Additionally, the respondent separation value which was 3.40 indicates that the students in this research can be well differentiated and can be categorized into three different abilities, namely low, medium and high.

In terms of validity, the researchers decided to retain all of the items because it was found that the items in the SIT instrument met at least one of the criteria for Outfit MNSQ, Outfit ZSTD, and PTMEA-CORR. In addition to that, all of the items had a positive PTMEA-CORR value, indicates that the item was moving in one direction (Bond & Fox, 2015). Besides that, all of the items also have an acceptable value for Outfit MNSQ, indicates that all items are consistent with the item measurement. Bond. and Fox (2007) stated that the value of Outfit MNSQ which is within the acceptable range is considered as good and productive for measuring the items. For the respondent fit, all of the students provided meaningful responses to the RMM since no students were discovered to be misfit according the RMM. In addition, the SIT instrument also has a strong evidence of unidimensionality (based on the analysis from PCA with a 96.9% variance explained by measures), implying that the SIT instrument measures what it is supposed to be measured that is the tenth graders' scientific imagination. Other than that, the unexplained variance value in the first contrast also was less than 15.0% (0.7 % to be exact) as suggested by Sumintono and Widhiarso (2015).

Generally, the findings discovered that the SIT instrument developed in this research has better findings as compared to the Scientific Imagination Test developed by Siew (2017) previously. For instance, the instrument's item reliability value in Siew (2017)'s study was 0.91, and this value was lower than the value obtained in the present research. Other than that, the analysis from PCA in Siew (2017) study which was 45.2% value for variance explained by measures, and 1.8% value for the unexplained variance value in the first contrast suggesting that the SIT instrument in the present research has stronger unidimensionality evidence. The comparisons of the findings from these two studies may indicate that improvements on the Scientific Imagination Test developed by Siew (2017) were successfully being done in the present research.

9. Conclusion

In conclusion, the analysis based on the RMM shows that the SIT instrument is reliable and valid instrument for measuring the scientific imagination of Tenth Grade students in secondary school. But the reliability and validity of this instrument need to be re-evaluated for future researchers who wish to use the SIT instrument in different type of group populations such as by using a sample from a different school grade in order to ascertain whether this instrument can be used to the other populations. The findings of this research are also important in adding useful information and references to the literature review, especially in the areas of scientific imagination. In addition, because there is very little research done on evaluating the scientific imagination among secondary school students, this research provides a reliable research instrument for measuring students' scientific imagination in the project-based learning, particularly in the context of secondary school science stream students, which also can serve as a useful reference for other researchers who wish to replicate or do similar researches.

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