

Validity of Dyscalculia Module for Pupils with Dyscalculia

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Abstract: There are three types of specific learning disorders, namely dyscalculia, dyslexia, and dysgraphia. Pupils with dyscalculia facing difficulties in acquiring basic arithmetic skills. Dyscalculia Module has been designed and developed for pupils with dyscalculia to learn basic arithmetic skills. The purpose of this study is to measure the validity of Dyscalculia Module among pupils with dyscalculia in basic arithmetic skills. Expert validation was carried out to measure the face validity, content validity, and activities suitability of Dyscalculia Module. Three experts in language were invited to evaluate the face validity, whereas nine experts in the field of special education, learning difficulties, Mathematics education, and module development were invited to evaluate the content validity and activities suitability. Percentages of validity achievement was used to measure the face validity, content validity, and activities suitability. The result shows that the language and terminology used in Dyscalculia Module achieved a good face validity measurement, with a face validity percentage of 86.66%. Dyscalculia Module has also achieved a good content validity measurement, with a content validity percentage of 87.50%. Other than that, the activities in Dyscalculia Module achieved a good suitability measurement, with activities suitability percentage of 85.44%. In conclusion, Dyscalculia Module achieved acceptable face validity, content validity, and suitability of activities. This study implicated that Dyscalculia Module is valid and the activities designed are suitable to improve the basic arithmetic skills among pupils with dyscalculia in primary schools. Future studies are recommended to implement Dyscalculia Module to pupils with dyscalculia in Malaysia and other countries.

Keywords: Dyscalculia; Basic Arithmetic Skills; Validity; Module; Mathematics

INTRODUCTION

Malaysia and other members of the United Nations Economic and Social Commission for Asia and the Pacific adopted the Incheon Strategy to Make the Right Real for Persons with Disabilities in Asia and the Pacific which comprises ten goals, 27 targets, and 62 indicators in November 2012 (Talib et al., 2018). Incheon Strategy to Make the Right Real for Persons with Disabilities in Asia and the Pacific placed emphasis on developments providing for people with intellectual and learning disabilities. According to this, great strides have been made in attitudes to learning difficulties (Harrison et al., 2018). Since the fifth goal of Incheon Strategy is to expand early intervention and education for pupils with disabilities, so modules for learning disabilities or difficulties among the pupils are crucial.

The signing of the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) marked national recognition of the rights for people with disabilities because it represents the social adoption, rather than a medical, model of disability (Njelesani et al., 2018). Article 24, paragraph 2(d) in the UNCRPD stated that persons with disabilities should receive the support they need within the system of general education to support their education effectively (United Nations, 2006). Support can be expressed in many ways, but individual needs should always be considered. All teachers must acquire the necessary competencies and skills to work in an environment with pupils having a diverse range of

abilities (Fina et al., 2020). Teachers must improve their knowledge in order to improve the quality of special education (Kasirah et al., 2023). Thus, the teachers should give proper intervention to the pupils with dyscalculia in the classroom to fulfil their educational needs.

Background

Figure 1.1 shows the number of pupils with special educational needs based on categories of disability. There are 6,937 pupils with physical disabilities, 3,539 pupils with multiple disabilities, 3,713 pupils with hearing impairment, 2,559 pupils with visual impairment, 919 pupils with speech difficulties, and 88,118 pupils with learning disabilities (Ministry of Education Malaysia, 2022). This data shows that pupils with learning disabilities occupied around 83.3 per cent among the population of pupils with disability.

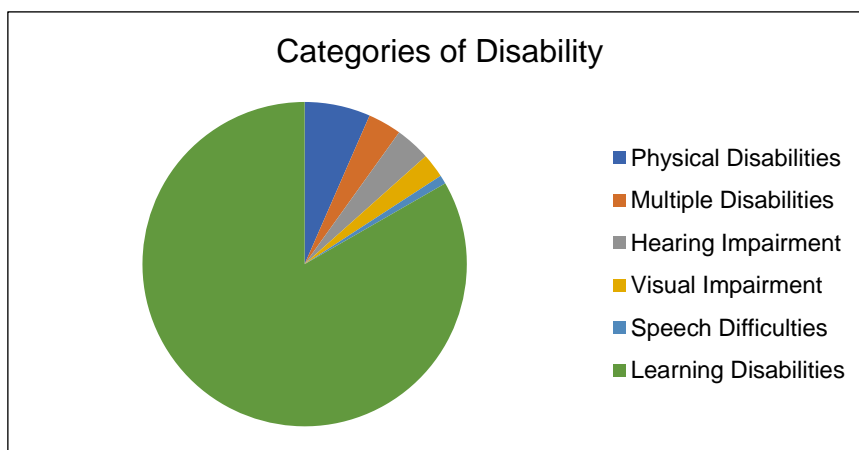


Figure 1. Number of Pupils with Special Educational Needs based on Categories of Disability

Source: Special Education Data, 2022

It was estimated that 4-6% of the pupils among the population are having the learning difficulties of dyscalculia (Bird, 2017). Dyscalculia affects between 4-7% of children (Butterworth, 2019). The presence of dyscalculia can impair the typical pupils' Mathematics performance. This learning difficulty in Mathematics happens among people across the whole Intelligence Quotient (IQ) range. The estimated prevalence of dyscalculia range is between 3-6% of the population. Previous study found out that 5.5% of the primary school pupils in Sabah are suffering from dyscalculia (Chin et al., 2014). Study showed that most teachers had limited strategies to support pupils with dyscalculia (Chin & Fu, 2021).

In short, it is a global concern to provide an appropriate and suitable teaching to every pupil, especially pupils with disabilities. The category of pupils with learning disabilities or difficulties are critical as they occupied the largest portion among pupils with disabilities. Many pupils have not reached the minimum proficiency in Mathematics even though it is the core subject in our education system. This is more critical among pupils with dyscalculia. Proper teaching and learning strategies and techniques are needed in order to support the pupils with dyscalculia.

In this study, Dyscalculia Module was designed and developed to improve the basic arithmetic skills among pupils with dyscalculia in primary schools. The content in Dyscalculia Module included basic arithmetic skills of addition, subtraction, multiplication, and division. These skills were selected as they are the basic foundation to learn other higher order skills and they are needed in our daily life. Hence, the researchers had developed an

intervention module for the learning of these four basic arithmetic skills suitable with the cognitive development level for pupils with dyscalculia. The purpose of this study is to measure the validity of Dyscalculia Module in the aspects of face validity, content validity, and suitability of activities.

Three research questions in this study are; (1) What is the face validity of Dyscalculia Module among pupils with dyscalculia in basic arithmetic skills?; (2) What is the content validity of Dyscalculia Module among pupils with dyscalculia in basic arithmetic skills?; and (3) What is the suitability of activities in Dyscalculia Module among pupils with dyscalculia in basic arithmetic skills?

Literature Review

The terminology of dyscalculia is coined for the first time by Dr. Kosciuszko in year 1974 (Espina et al., 2022). Pupils with dyscalculia are facing difficulties in basic numerical skills (Wong et al., 2020). Dyscalculia affects the academic achievement, social relationship, and even lifestyle of an individual (Yoong & Ahmad, 2020). Studies showed that dyscalculia is as common as dyslexia, however the researches on dyscalculia is very less if compare with dyslexia (Yoong & Ahmad, 2021). Furthermore, mathematics is a difficult subject for some students due to the demands of logical thinking in studying mathematics (Amatullah et al., 2023). More researches should be carried out, especially to assist the pupils with dyscalculia.

Dyscalculia is one of the distinct categories of specific learning disability, other than dyslexia and dysgraphia (Nadiyah et al., 2022). It is a specific learning difficulty characterized by arithmetic difficulties (Gobel et al., 2022). Teachers need to assess their pupils' basic arithmetic skills precisely and comprehensively in order to identify appropriate learning goals for each pupil and plan instruction efficiently (Dessemontet et al., 2019). Basic arithmetic skills refer to four basic operations in Mathematics, namely addition, subtraction, multiplication, and division (Yoong et al., 2022). These four basic arithmetic skills should be taught in a systematic way especially to pupils with dyscalculia.

The evaluation of validity needs to be determined prior to the actual field study. This is to ensure that the instrument was relevant and adequate to confirm its credibility (Shafie et al., 2021). Content validity ensures that operationalization of the construct is based on items which are taken from the specific domain of content relevant to the particular measurement situation (Shrotryia & Dhanda, 2019). Questionnaire of content validity needs to be sent to the experts in the same field of the study. This questionnaire was allowed to delivered to experts working at various locations (Taherdoost, 2016). Other than content validity, suitability questionnaires should be validated by a group of experts. Suitability of activities need to be evaluated based on numeric scores and comments by the experts in content (Shyielathy et al., 2019). In this study, face validity, content validity, and activities suitability of Dyscalculia Module were evaluated and determined.

METHOD

Content validity ensures that operationalization of the construct is based on items which are taken from the specific domain of content relevant to the particular measurement situation. It is recommended to involve a minimum of three experts in determining the content validity (Shrotryia & Dhanda, 2019). Percentages for face validity, content validity, and activities suitability were investigated.

Research Procedures

Face validity of Dyscalculia Module was used to evaluate the language used in Dyscalculia Module. Face validity questionnaire for Dyscalculia Module was distributed to

three experts in Malay language. The formula below shows the calculation to obtain the face validity achievement for Dyscalculia Module.

$$\frac{\text{Total Score from Expert}}{\text{Maximum Score}} \times 100\% = \text{Face Validity Achievement}$$

The content validity of Dyscalculia Module was evaluated by nine experts in the field of special education, learning difficulties, Mathematics education, and module development. Content validity questionnaire for Dyscalculia Module was distributed to the experts through emails or by-hand. Ten-point likert scale were ticked by the experts, where [1] represents strongly disagree and [10] represents strongly agree. The formula below shows the calculation to obtain the content validity achievement for Dyscalculia Module.

$$\frac{\text{Total Score from Expert}}{\text{Maximum Score}} \times 100\% = \text{Content Validity Achievement}$$

Other than that, activities suitability was measured for every activity in Dyscalculia Module. Suitability questionnaire for Dyscalculia Module was distributed to nine experts in the field of special education, learning difficulties, Mathematics education, and module development. There were four basic arithmetic skills involved in this module, where each consists of three different techniques. This activities suitability questionnaire was adapted with the permission of Professor Dr. Mohammad Aziz Shah Mohamed Arip from Sultan Idris Education University (UPSI). The formula below shows the calculation to obtain the activities suitability achievement for Dyscalculia Module.

$$\frac{\text{Total Score from Expert}}{\text{Maximum Score}} \times 100\% = \text{Activities Suitability Achievement}$$

Instruments

Three instruments implemented in this study are; (1) face validity questionnaire; (2) content validity questionnaire; and (3) activities suitability questionnaire. The first instrument is face validity questionnaire. There are ten items in this questionnaire. The items are; (1) the language used in Dyscalculia Module suits the context of study; (2) the language used in Dyscalculia Module is easy to understand; (3) the terminology used in the Dyscalculia Module is accurate; (4) the instruments in Dyscalculia Module are free from grammatical errors; (5) definition for each activity in Dyscalculia Module are clear; (6) instructions in Dyscalculia Module are clear; (7) text size in Dyscalculia Module is appropriate; (8) font size in Dyscalculia Module is acceptable; (9) the activities developed are in line with the objectives of study; and (10) pages in Dyscalculia Module can be read clearly.

The second instrument is content validity questionnaire. Content validity questionnaire for Dyscalculia Module consisted of eight items. The items are; (1) the content of Dyscalculia Module meets the target population; (2) the content of Dyscalculia Module can be carried out perfectly; (3) the content of Dyscalculia Module is suitable with the allocated time; (4) the content of Dyscalculia Module is suitable with the Mathematics syllabus for learning difficulties in primary schools; (5) the content of Dyscalculia Module is comply with the concepts of thinking skills teaching approach; (6) the content of Dyscalculia Module has sufficient multimedia elements to explain about the mathematical concepts involved; (7) the content of Dyscalculia Module can improve mathematical skills among pupils effectively; and (8) the content of Dyscalculia Module used the suitable terms according to Mathematics

(learning difficulties) syllabus in primary schools. The experts need to tick on the ten-point likert scale where [1] represents strongly disagree and [10] represents strongly agree.

The third instrument is activities suitability questionnaire. Activities suitability questionnaire for Dyscalculia Module consisted of four parts, namely addition, subtraction, multiplication and division. Each part contained of three different techniques. Three techniques for addition skill are Dots-Cards, Down-Dots, and Speedline; three techniques for subtraction skill are Dots-Cards, Up-Dots, and Speedline; three techniques for multiplication skill are Dys-Cross, Dys-Squares, and Dys-Lines; and three techniques for division skill are Dys-Cross, Dys-Dots, and Dys-Arrays.

Expert Panels

Face validity of Dyscalculia Module was evaluated by three experts in Malay language. On the other hand, content validity and suitability of activities for Dyscalculia Module were evaluated by nine experts in the field of special education, learning difficulties, Mathematics education, and module development. Figure 2 shows expert panels in evaluating the validity of Dyscalculia Module.

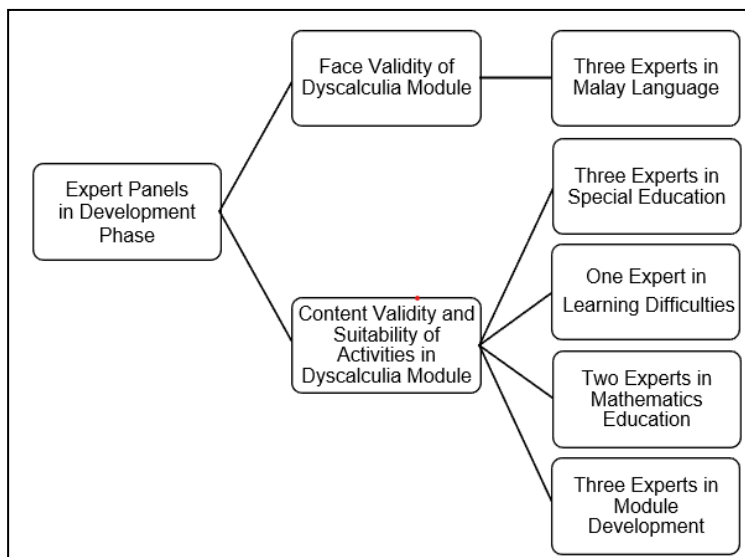


Figure 2. Expert Panels in Evaluating the Validity of Dyscalculia Module

RESULT AND DISCUSSION

Result

Validity of Dyscalculia Module has been evaluated by three experts in Malay language and nine experts in content. In this section, the validity of Dyscalculia Module was discussed based on face validity, content validity, and activities suitability.

Face Validity

Dyscalculia Module was validated by three language experts. Table 1 shows the face validity for Dyscalculia Module. Based on the table, the total scores given by expert one, expert two, and expert three were 75, 87, and 98 respectively. From the calculation of percentage from the expert given scores, Dyscalculia Module has achieved the face validity measurement for the language of 86.66 per cent with a coefficient value of 0.87.

Table 1. Face Validity for Dyscalculia Module

No.	Expert 1	Expert 2	Expert 3
1	7	9	9
2	7	9	10
3	9	9	9
4	7	7	10
5	8	8	10
6	6	9	10
7	5	9	10
8	10	9	10
9	9	9	10
10	7	9	10
Total	75	87	98
Face Validity Achievement (100%)			86.66
Face Validity Coefficient (1.00)			0.87

The face validity coefficient of Dyscalculia Module was 0.87, which was larger than 0.70. Based on this result, the language and terminology used in Dyscalculia Module achieved good face validity measurement. Other than face validity, content validity is important as it determined how accurate the content measured what it is intended to measure. Thus, the content validity of Dyscalculia Module will be discussed in the next section.

Content Validity

Dyscalculia Module was sent to nine experts in the field of special education, learning difficulties, Mathematics education, and module development to evaluate its content validity. The expert panels consisted of three experts in the field of special education, one expert in the field of learning difficulties, two experts in Mathematics education, and three experts in module development.

Table 2 shows the content validity measurement for Dyscalculia Module. Based on the percentage calculation from the scores given by experts, Dyscalculia Module has achieved the content validity measurement of 87.5 per cent with a validity coefficient value of 0.88, and it was above 70 per cent or 0.70. Based on the result, the content in Dyscalculia Module achieved good validity measurement.

Table 2. Content Validity for Dyscalculia Module

No.	E1	E2	E3	E4	E5	E6	E7	E8	E9
1	9	9	9	9	7	10	10	9	10
2	9	9	8	9	7	10	10	8	10
3	9	8	8	9	7	10	10	8	10
4	9	7	9	9	7	10	10	9	10
5	9	8	7	9	7	10	10	9	10
6	9	9	8	9	7	10	9	8	10
7	8	8	7	9	7	10	10	8	10
8	8	7	7	9	7	8	10	8	10
Total	70	65	63	72	56	78	79	67	80
Content Validity Achievement (100%)									87.50
Content Validity Coefficient (1.00)									0.88

Table 3 shows the suggestions from experts in content validity questionnaire. Based on the table, expert one acclaimed that Dyscalculia Module and its activities are good.

However, suggestion was given to make improvements after reliability report or implementation of pilot study. The comment from expert four was based on the selection of population and sample of pupils with dyscalculia. Advice was given to differentiate the pupils with dyscalculia or pupils at risk with dyscalculia and the Mathematics low achievers.

In addition, expert five suggested that the content of module needs to be developed based on pupils' ability level. Bloom Taxonomy was recommended in this matter. Expert six also suggested to create questions relevant to pupils' daily life. Other than that, expert seven suggested the teachers to slow down the speech delivery. This expert also commented that there is a possibility that pupils are having hearing disability, cognitive disability, or weak in the aspects of reasoning.

Table 3. Suggestions from Experts in Content Validity Questionnaire

Expert	Suggestions from Experts
1	The module and the activities are good and compatible with the theoretical and objectives of the module. Improvements are suggested to be made after the report of reliability or pilot implementation.
2	-
3	-
4	Make sure the population of pupils with dyscalculia or pupils at risk with dyscalculia are identified and their characteristics are clearly explained. Need to differentiate between Mathematics low achievers and pupils with dyscalculia or at risk.
5	The content of module needs to be developed based on pupils' ability level. It is recommended to follow Bloom's Taxonomy.
6	1. Congratulations for successfully producing a good research material. 2. It is suggested if there is any existing question relevant to pupils' daily life as outlined in primary school Mathematics curriculum.
7	Teacher's explanation in module needs to slow down because teacher's speech is too fast. It is worried that pupils are not able to hear clearly and this will make them confuse. Teacher needs to be aware that pupils are likely to have hearing disability, cognitive disability, or weak in the aspects of reasoning.
8	-
9	-

In compliance with comment from expert one, a pilot study was carried out. Reliability of Dyscalculia Module was measured. Improvement for Dyscalculia Module was made after the pilot study. Regarding the comment from expert four, pupils with dyscalculia or at-risk pupils with dyscalculia were differentiated from Mathematics low achievers by giving a briefing to Mathematics teachers on the symptoms of dyscalculia. The Mathematics teachers selected the symptomatic pupils with dyscalculia. A pre-test was carried out to these pupils to ensure that they have not master in basic arithmetic skills. For those who have master in the core skills, they were excluded from the study.

In accordance to comment from expert five, the content of module was developed based on the pupils' cognitive development level. Hence, this study applied four cognitive development stages based on Piaget's Cognitive Development Theory instead of the learning levels of Bloom's Taxonomy. Expert six gave suggestion on creating questions relevant to pupils' daily life. Justification for not inserting items relevant to pupils' daily life is because the module was focused on the four basic arithmetic skills, instead of other problem-solving skills in daily life.

Expert seven suggested the teachers to slow down the speech delivery as there is a possibility that pupils are having other disabilities, such as hearing disability, cognitive disability, or weak in the aspects of reasoning. However, the sample selection in this experimental study has excluded pupils with the above-mentioned disabilities, but focused on pupils with symptomatic dyscalculia. In addition, the video can be played as many times

as possible if the pupils were unclear about the instruction. Teacher will also act as the facilitator to explain and assist the pupils in order to understand the instruction for each technique.

Activities Suitability

Table 4 shows suitability of activities for Dyscalculia Module. Based on the percentage calculation from the scores given by experts, activities in Dyscalculia Module achieved the validity measurement for the suitability of 85.44 per cent with a suitability coefficient value of 0.85, and it was above 70 per cent or 0.70. Based on the results, the activities in Dyscalculia Module achieved a good suitability measurement.

Table 4. Suitability of Activities for Dyscalculia Module

Activities	E1	E2	E3	E4	E5	E6	E7	E8	E9
Addition									
1. Dots-Cards	0.90	0.83	0.77	0.90	0.70	1.00	1.00	0.80	1.00
2. Down Dots	0.83	0.83	0.73	0.90	0.70	1.00	1.00	0.80	1.00
3. Speedline	0.87	0.83	0.83	0.90	0.70	1.00	1.00	0.80	1.00
Subtraction									
1. Dots-Cards	0.87	0.87	0.67	0.90	0.70	0.90	1.00	0.80	1.00
2. Up Dots	0.83	0.83	0.77	0.90	0.70	0.90	1.00	0.80	1.00
3. Speedline	0.83	0.83	0.77	0.90	0.70	0.90	1.00	0.80	1.00
Multiplication									
1. Dys-Cross	0.85	0.85	0.75	0.90	0.70	0.90	1.00	0.80	1.00
2. Dys-Squares	0.85	0.80	0.75	0.90	0.70	1.00	1.00	0.80	1.00
3. Dys-Lines	0.85	0.80	0.75	0.90	0.70	1.00	1.00	0.80	1.00
Division									
1. Dys-Cross	0.85	0.75	0.75	0.90	0.70	0.90	1.00	0.80	1.00
2. Dys-Dots	0.85	0.90	0.65	0.90	0.70	0.90	1.00	0.80	1.00
3. Dys-Arrays	0.85	0.80	0.70	0.90	0.70	0.90	1.00	0.80	1.00
Average	0.85	0.76	0.74	0.90	0.70	0.94	1.00	0.80	1.00
Content Validity Achievement (100%)									85.44
Content Validity Coefficient (1.00)									0.85

Discussion

The findings showed that Dyscalculia Module has achieved good face validity, content validity and activities suitability. Three language experts were invited to evaluate the face validity, whereas another nine experts were invited to evaluate the content validity and suitability. This is in line with Shrotryia and Dhanda (2019) who stated that a minimum of three experts should be involved in the evaluation of validity.

The purpose of this study is to measure the validity of Dyscalculia Module in the aspects of face validity, content validity, and suitability of activities. Overall, all of the findings have met the purpose of the study. The findings on face validity, content validity, activities suitability of Dyscalculia Module are above 0.70. This is in line with Talib, Mohamad, & Wahab (2015) who mentioned that a module is considered to have good content validity if the level of content validity achieved 0.70.

Due to the limited number of experts in the field of dyscalculia, the researcher had invited the content experts from the fields of special education, learning difficulties, mathematics education, and module development. Future researchers are recommended to

explore the expertise in the field of dyscalculia. They are also suggested to invite dyscalculia experts from other countries in their studies.

CONCLUSION

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ACKNOWLEDGMENTS

We would like to acknowledge SEAMEO SEN for organising this wonderful event. Besides, we also thanks to committee members of International Conference on Special Education (ICSE 2023). Appreciation goes to Professor Dr. Mohammad Aziz Shah Mohamed Arip for the permission to adapt the suitability activities questionnaire. We would also thanks to all the experts involved in this research. Lastly, the first author would like to express her gratitude to Ministry of Education Malaysia for sponsoring her doctoral study.

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