DEVELOPMENT OF A WORKING MEMORY TEST AND A WORKING MEMORY STRATEGIES PROGRAMME FOR MIDDLE SCHOOL STUDENTS

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Abstract

In educational sectors, interest in working memory has been increasing in society because it can predict academic achievement and professional success. However, in Basic Education, there has been little discussion about the importance of working memory for students and the way to improve their working memory. To address this gap, a working memory test and a working memory strategies programme were developed for middle school students in Myanmar. Working Memory Test was developed based on Baddeley's Working Memory Model. A total of 122 Grade 8 students (60 males and 62 females) from Magway Region participated in this study. Classical test theory (CTT) was applied in developing the working memory test. Then, developing a working memory strategies programme to train middle school students' working memory is of interest. By applying what students know about how their memory works, teachers can concentrate on the learning aspects of the teaching-learning process. In addition, students' working memory will be improved by applying working memory strategies systematically and, as a result, can enhance the teaching-learning process.

Keywords: Working memory, working memory test, working memory strategies, teaching learning process

Introduction

As technology continues to place endless amounts of information at our fingertips, working memory has become even more essential to our ability to function successfully. Since working memory allows us to focus our attention and organize the things, we do every day, it plays as central factor in everyday activities especially the three phrases: social, academical, and professional. Socially, we use working memory in the moment we are meeting someone and hearing their name, phone number for the first time. Academically, it is used when we perform in all aspects of the classroom such as lecturing, taking notes, etc. Professionally, working memory is what drives our ability to concentrate and not lose our train of thoughts.

Memory is the process of storing and retrieving information in the brain. It is the process of memory that is central to our learning and thinking. Human beings are continually learning throughout their lifetime. Only some of this massive volume of information is selected and stored in the brain, and is available for recall later when required. Learning is the acquisition of new knowledge, and memory is the retention of this knowledge. The combination of learning and memory, therefore, is the basis of all our knowledge and abilities. It is what enables us to consider the past, exist in the present and plan for the future.

Working memory means from the educational viewpoint as that part of the brain where holding the information, working upon it, organizing it, and shaping it, before storing it in long-term memory for further use (Johnstone, 1984). The working memory space is very limited in terms of both its capacity (amount of information it can hold) and its duration (length of time it can hold information). Furthermore, working memory space depends on the age of the individual. As Miller (1956) showed in his memory experiments, the average capacity is about seven plus or minus two (7±2) separate chunks. Chunking is the process of grouping into units which could be

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a single number, a letter, or many pieces of information, and the nature of the items plays a major role in the capability to recall (Miller, 1956). This chunking process plays a key role in training working memory to improve.

In the field of education, many of the learning activities that children are engaged with in the classroom, whether related to reading, mathematics, science, or other areas of the curriculum, impose quite considerable burdens on working memory. Mentally changing occurs while holding some information to the child who is doing something different activities. The children with poor working memory fail the activity that they should make completely because of losing working memory, the crucial information needed to guide their activity. As a result, the rate of learning will be slow down.

Living with a poor working memory would be like running many software programmes simultaneously on a computer with little random-access memory (RAM) - it would be slow, frustrating and very inefficient. In short, it wouldn't work the way it needs to actually. Also, some students forget the instruction before the task is completed because of their working memory strength that controls what to do after another. That is why, poor working memory makes the students fail to follow the classroom activities in normal rate (Holmes, 2012).

In this research, Baddeley's (2000) model, the multi component model, is of most essential. This model consists of four parts: the phonological loop, the visuospatial sketchpad, the episodic buffer and the central executive. The phonological loop manages auditory information. The phonological loop consists of two parts. The first one is a passive storage where holding the information a few seconds and then disappear. In order to retain information, the phonological loop's second part, the articulatory system, is activated. This system provides a description of how memory actually works accurately when we handle auditory information (Baddeley, 2000).

The visuospatial sketchpad handles visual and spatial information. Information are transformed into visual impression and spatial code. The visuospatial sketchpad is also necessary for our ability to create and manipulate mental image. The sketchpad can be divided into two parts: a visual part that takes care of information about objects, shapes and colours and a spatial part that manages information about movement and direction.

The latest addition to Baddeley's working memory model is the episodic buffer. It is a temporary storage, where information from the incoming impressions, the phonological loop and the visuospatial sketchpad are integrated with information from long-term memory. The episodic buffer is considered important for learning because it can use multimodal code to integrate information from different systems into a single representation.

The central executive also called the executive system coordinates and monitors the other systems in working memory. In addition, several aspects of how we use our attention are guided by the executive system. Firstly, the executive system determines our ability to focus attention and our ability to close our impressions that compete for our attention. This system also controls our ability to divide attention between several tasks simultaneously (Grant, 2011).

In developing a test, most important considerations are validity and reliability of a test. Validity in test items refers to reliability of test items in measuring students' ability. Validity refers to the degree to which assessment scores can be interpreted as a meaning indicator of the construct of interest. It consists of several results: content validity, item difficulty and item discrimination. Content validity is defined as any attempt to show that the content of the test is a representative sample from the domain that is to be tested (Fulcher & Davidson, 2007). To analyze content validity, the area is about what is measured by the test and make judgments about content validity. Content validity is the most common validation that the researcher uses to ascertain if a test provides an accurate assessment of instructional objectives (Miller, 2008).

Item difficulty refers to items with one correct alternative worth a single point; the item difficulty is simply the percentage of students who answer an item correctly. Item difficulty is relevant for determining whether students have learned the concept being tested. It also plays an important role in the ability of an item to discriminate between students who know the tested material and those who do not. Item discrimination refers to the ability of an item to differentiate among students on the basis of how well they know the material being tested. In item discrimination, it is related to discriminate between strong and weak students in other words we can say that the upper group and the lower group. Strong students or upper group mean the test takers who have many correct answers in their test. The weak students or the lower group is the test takers that have less correct answers in their test (Fulcher & Davidson, 2007). Reliability in test refers to test items which have consistent result in measuring students' achievement. The standard of reliability is answers to test questions that will be consistently trusted to represent what students know (Clay, 2001).

Based on the above literature review, recognizing the essential of working memory and the lack of working memory test for middle school students, this study is an attempt to develop a working memory test for middle school students. Then, developing a working memory strategies programme is also done sequentially.

Aim and Objectives

The primary aim of this study is to enhance the teaching learning process in basic education by exploring and training middle school students' working memory.

The specific objectives were:

(1) To develop a working memory test for middle school students

(2) To explore middle school students' working memory

(3) To develop a working memory strategies programme to train middle school students' working memory

Definitions of Key Terms

Working Memory : the brain system that provides temporary storage and manipulation of the information necessary for such complex cognitive tasks as language, comprehension, leaning and reasoning (Baddeley, 1992)

Working Memory Test : an assessment instrument designed to measure a wide range of information-processing functions such as encoding, storing, and retrieving data (Operational Definition)

Working Memory Strategies : a program of training action designed to achieve a goal (higher working memory) or accomplish a task (APA Dictionary of Psychology)

Method

Research Design

The design used in this study was quantitative research design. Descriptive survey method was utilized in the present study.

Sample of the Study

By using random sampling technique, the schools and students were selected from Pakokku District, Magway Region. The number of the students administered by schools was 122 (60 males and 62 females).

Planning the Test

The objective of the test is to measure working memory of middle school students. Working memory is the brain system that provides temporary storage and manipulation of the information necessary for such complex cognitive tasks as language, comprehension, leaning and reasoning (Baddeley, 1992). The first step is to prepare a table of test content specification.

There are numerous techniques to measure the capacity of working memory space. In the present study, Working Memory Test was developed by the researcher, based on the working memory models and Pickering's Digit Span Test, Corsi's Block Recall Test, Pascual-Leone and Smith's Standardized Figural Intersection Test and Books on memory tests (Carter, 2009). At first, the sample items were carefully studied and an item pool of 94 was developed with respect to the age of the students. Number of items in each subtest are different depending on the time taken for answer.

In working memory test, there are seven subtests that assess the central executive, phonological loop and visuospatial sketchpad components of working memory. These tests are: Digit Span Test, Digit Backward Test, Word Memory Test, Letter Memory Test, Picture Memory Test, Figural Intersection Test, and Block Recall Test.

1. Digit Span Test

In this task, the examiner reads a sequence of digits in a rate of time one item per second (e.g., "3, 5, 9, 4") and the students must immediately repeat them back and write down the answer sheet. The sequential digits are read to students in an even monotone, in order to discourage any grouping likelihood of the items on the basis of intention and prosodic information (Pickering, 2006).

2. Digit Backward Test

In this task, the examiner reads to the students a series of digits and asks them to write them in revise order (Alenezi, 2008). For example, 38975 would return as 57983. Every digit is read to the students in a rate of one digit per second and the same time is given to recall after the reading of the whole series is over. After the students finish the task, they will receive a new task with a great number of digits and so on.

3. Word Memory Test

In this task, the examiner shows the list of words with the projector and asks the students to write the words as they can (Batt et al., 2008).

4. Letter Memory Test

In this task, the examiner shows the list of letters and asks the students to write down the answers for each question (Greub & Suhr, 2006).

5. Picture Memory Test

In this task, the examiner shows the similar and various pictures and asks the different questions about the pictures to the students (Carter, 2009).

6. Figural Intersection Test

In every task, the students are asked to find the overlapping area of a set of simple shapes, which intersect to form a complex design. As the number of figures increases, the task becomes more complex (Pascual-Leone & Smith, 1969).

7. Block Recall Test

In this task, a sequence is tapped out on the blocks with the projector by the examiner and then, the students are required to repeat the sequence in the same order as they have been shown (Corsi, 1972).

With respect to the ambiguity of meaning and the conformity, the editorial review of items by ten experts from Department of Educational Psychology, Yangon University of Education for face validity and content validity. Based on this review, some wording and instructions were revised and then used for piloting. The table of content specifications for Working Memory Test was detailed as shown in Table 1.

Table 1. Content Specification of Working Memory Test

No.	Subtests	Number of Items	Given marks for each item	Total Marks	Time Allowed	Estimated Items
1.	Digit Span Test	20	1	20	10 min	7
2.	Digit Backward Test	20	1	20	10 min	6
3.	Word Memory Test	3	10	30	10 min	1
4.	Letter Memory Test	23	1	23	10 min	7
5.	Picture Memory Test	13	1	13	10 min	4
6.	Figural Intersection Test	9	1	9	10 min	3
7.	Block Recall Test	6	1	6	10 min	2
	Total	**94**		**121**	**70 min**	**30**

There are 94 items in the piloting. The most relevant 30 items out of them were utilized to examine middle school students' working memory. Each item in this test will be scored 1 for correct answer and 0 for incorrect answer.

Piloting Results

This pilot study was conducted with a sample of 122 Grade-8 students (61 boys and 61 girls) in Basic Education High School, Yesagyo during the first week of March in 2020. The test takes 70 minutes to complete. Item analysis, editing and selection procedures were performed.

At this stage, difficulty index and the discrimination index for each item were calculated. The difficulty index is used to assess item difficulty and the discrimination power is used to assess item quality. The difficulty index is the proportion of examinees who answer the items

correctly and its value may range from 0 to +1. The discrimination power is the degree to which success or failure on an item indicates possession of the ability being measured. It determines the extent to which the given item discriminates among examinees in the function or ability measured by the item. This value ranges from -1 to +1. For reliability in test items, the researcher calculated the internal consistency (Cronbach's Alpha). The value of this test was 0.88. The values of difficulty and discrimination for each selected item were mentioned in Table 2.

Table 2. The Values of Difficulty Index and Discrimination Power of Selected 30 Items

Item Number	DI	DP	Item Number	DI	DP
Item 1	0.75	0.39	Item 16	0.52	0.39
Item 2	0.64	0.42	Item 17	0.61	0.39
Item 3	0.49	0.45	Item 18	0.51	0.52
Item 4	0.50	0.39	Item 19	0.70	0.33
Item 5	0.32	0.30	Item 20	0.55	0.48
Item 6	0.42	0.48	Item 21	0.70	0.45
Item 7	0.39	0.45	Item 22	0.58	0.45
Item 8	0.68	0.48	Item 23	0.73	0.36
Item 9	0.61	0.61	Item 24	0.63	0.36
Item 10	0.73	0.45	Item 25	0.72	0.24
Item 11	0.70	0.42	Item 26	0.63	0.21
Item 12	0.61	0.52	Item 27	0.56	0.21
Item 13	0.64	0.61	Item 28	0.88	0.21
Item 14	0.63	0.58	Item 29	0.74	0.36
Item 15	0.73	0.42	Item 30	0.62	0.39

Note. DI = difficulty index, DP = discrimination power

In conducting the item analysis, it was found 18 items having high DI values more than 0.90, 16 items having high DI values more than 0.75 and 2 items having low DI values less than 0.20. The high DI value implies that the item was very easy and the answer was probably too obvious for the examinee groups. The low DI value implies that the item was very difficult to answer for the examinee. So, they were discarded from the test.

Moreover, there were 27 items having DP values less than 0.20 and 1 item having negative DP value. This means that low performing students selected the correct answer more often than high scores. Thus, these items were rejected. According to the result, 30 items that were between 0.30 and 0.75 DI value and equal to or greater than 0.21 DP value were chosen. Among these items, some items having DP value less than 0.40 will be improved by the researcher. Therefore, these 30 items out of 94 items were used to explore students' working memory.

The revised working memory test of 30 items consists of 7 items for digit span test, 6 items for digit backward test, 1 item for word memory test, 7 items for letter memory test, 4 items for picture memory test, 3 items for figural intersection test and 2 items for block recall test. Each participant had 45 minutes to complete the working memory test. As 10 subtest items contained in word memory test, there were 39 items in total including main items and sub- items.

Data Analysis and Results

Working Memory Level of Middle School Students

According to the second objective of this study, the working memory level of middle school students was explored. The descriptive analysis revealed that the mean and standard deviation for the whole sample are 24.39 and 7.30 (see Figure 1).

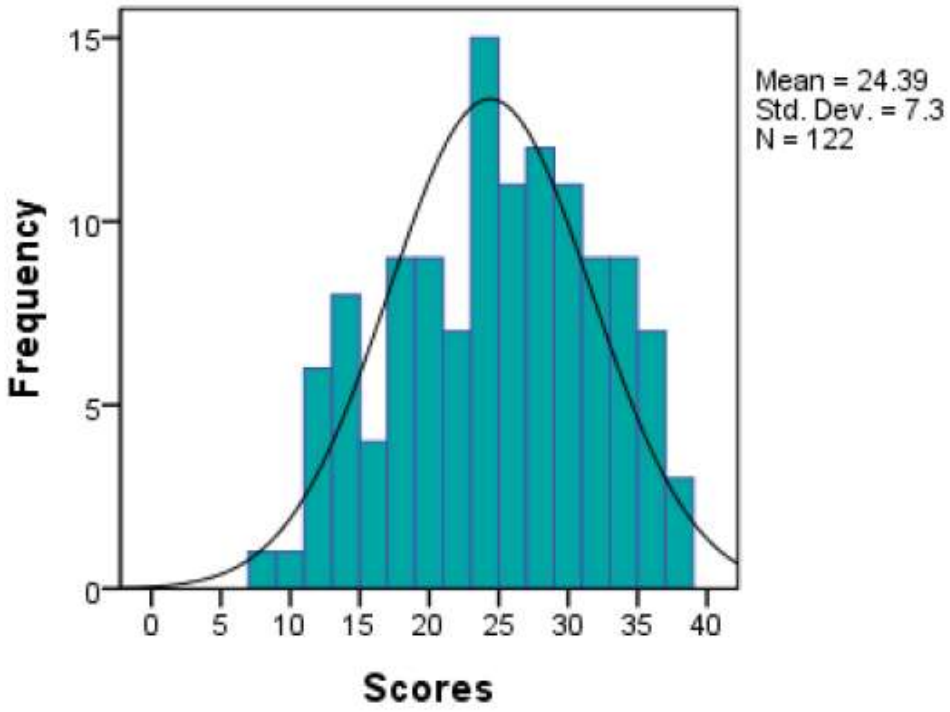

Figure 1. Working Memory Level of Middle School Students

The following Table 3 presented the level of students' working memory according to the scoring system which is based on the method of scoring of memory test (Carter, 2009).

Table 3. Frequency Distribution for Middle School Students' Working Memory Scores

Range of Scores	Students	
	Frequency	Percentage (%)
35-39	10	8
27-34	41	34
20-26	38	31
12-19	28	23
below 12	5	4
Total	**122**	**100**

According to the result table, 8% of students (range of scores 35-39) were exceptional in working memory level. Moreover, 34% of students (range of scores 27-34) have very good working memory. There were 31% of students (range of scores 20-26) who got good above average level of working memory. Among them, 23% of students (range of scores 12-19) were at

average level of working memory and 4% of students got scores below 12. It might be interpreted that they were below average level of working memory.

According to descriptive analysis, middle school students could be identified into 3 groups: 42% of students who have high level working memory, 31% of students who have middle working memory level and 27% of students who have low working memory. (See Figure 2)

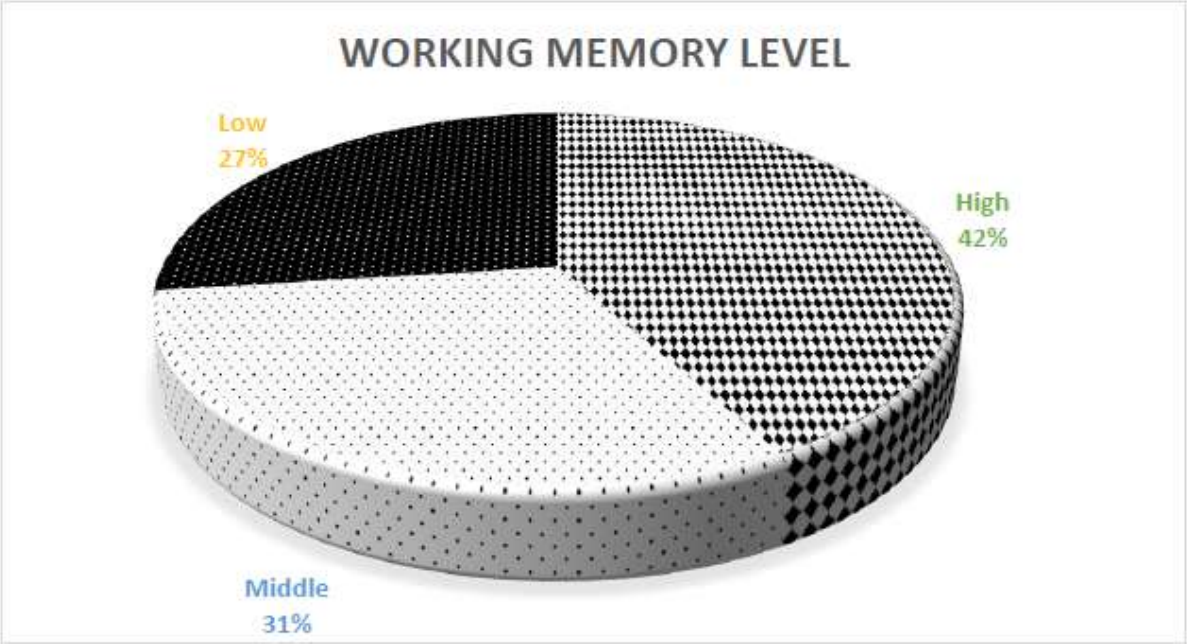

Figure 2. Three Groups of Middle School Students' Working Memory

Based on the results, the researcher implements a working memory strategies programme for middle school students. By applying this programme systematically, students' working memory will be higher and higher.

Working Memory Strategies Programme for Middle School Students

Working memory is a fundamental cognitive function that is necessary for us to perform a number of mental activities, such as reading, counting and problem-solving. With the help of working memory, we can maintain and process a limited amount of information for a short time. In other words, working memory is our ability to keep things in mind in real time. We use working memory in daily activities for example, when we remember a phone number or when we follow an instruction, we use working memory essentially. With good working memory, we can better concentrate and deal with distractions. Many of the working memory programmes including computer training (Backman & Truedsson, 1967) and classroom strategies (Gathercole & Alloway, 2007) suggest that working memory training can lead to improve working memory and then successive learning ability (Newby, 1991).

There are many working memory training programmes including computer trainings but in basic education of Myanmar, the uses of computers are very much little. So, in this research, based on the memory games, working memory improving strategies and training (Truedsson & Strohmayer, 2010), working memory strategies programme was explored by the researcher. In this research, working memory training programme consists of a number of memory exercises that should be completed at each training session.

With respect to the ambiguity of meaning and the conformity, the editorial review of items by ten experts from Department of Educational Psychology, Yangon University of Education for face validity and content validity. And, 10 Grade 8 students in Yesagyo participated in pre- piloting. Based on the experts' review and the test taker's review, some wording, items and instructions were revised.

The training periods take place for six weeks, five days per week and forty-five minutes per day. Thirty sessions are included in this programme. Working memory strategies programme was developed based on four principles – chunking (C), visualization (V), association (A) and concentration (C). Chunking means the process of taking individual pieces of information (chunks) and grouping them into larger units. Visualization means changing the information into a picture or movie with your mind. Association means linking the information with an image or prior knowledge together. Concentration means focusing on the information you want to record or remember.

1. Procedures for Chunking Method

At the beginning of the working memory training, the students are explained about the training programme thoroughly. The benefits of the training programme are also explained, for example, improving the memory at the end of the training. In addition, the rules and principles followed, and the assessment and reward section are explained to the participants. The goal of this method is to remember the numbers easily and sequentially without forgetting easily and to store into long term memory and retrieve in future time.

First session, the researcher introduces the participants a very important phenomenon, namely chunking method. The number of items that normal person can memorize is about seven (Miller, 1956). So, when we have to memorize something, we had to try to encode the information in as few units as possible. We try to the group the information into larger chunks.

As the number of chunks we can remember are limited according the age groups (children, adult), we try to gather as much information as possible in each chunk to maximize the amount of information we can remember. For example, the phone number 256356835, instead of memorizing these nine digits as one chunk, three digits 256-356-835 as three chunks should be memorized. And then, a large numbers of items pool will be practiced together with the researcher by chunking and repeating methods.

2. Procedures for Visualization Method

The goal of this method is to focus on visualization (V). At the end of the training period, the participants had to possess the ability changing the information into a picture, or movie with their mind in memorizing the information. According to the literature, a normal person can memorize much data 25 times by visual than by auditory. And the proverb "a picture speaks a thousand words" is confirmed.

In these sessions, the participants are given many pictures and memorized them. After a few seconds, a pair of similar pictures is given and the participants are asked to choose the former picture. The participants are expected to choose the correct picture. Then, the participants are made the information change the image and memorize. In the last sessions, the participants are tested with visual exercises.

3. Procedures for Association Method

The purpose of this method is to have the sense to link the information together with the image or with the previous knowledge and memorize the information. Association (A) means chaining the information and thus one point is retrieved and the other information is remembered automatically. Creativity and imagination are very important in association process. In this session, the participants are talked to memorize the information by association.

The examples of the words are:

1. Bicycle	7. Sun	13. Computer
2. Pencil	8. Flower	14. Apple
3. Stove	9. Park	15. T-shirt
4. Shark	10. Spider Man	16. Horse
5. Dolphin	11. Bread	17. Tissue
6. Whale	12. Cycle	18. Coffee

The above 18 words are memorized in normal way. After a few minutes, the participants are asked these words. Most students will answer 7-10 words. The first word (bicycle), the last word (coffee), the strange word (spider man) and the same group (shark, dolphin, whale) will be remembered most. And other words will be missed. The researcher will discuss the participants why don't we memorize these random words correctly in short time. Then, the researcher makes the participants link these words in image and create an image. In this way, these 18 words are memorized correctly and sequentially. That is why, association becomes one of the suitable strategies we use to memorize.

In the last sessions, the participants are given the items and memorizing and practicing will be conducted by using the association strategy.

4. Procedures for Concentration Method

In this session, the participants are guided to focus on the information they want to record (Concentration, C). Like camera, our memory can memorize by focusing clearly the information we want. We can't remember what we didn't see or hear in the first place. So, concentration power is very important in promoting memory. In the second session, to make the images in our head memorable, the factors - Size, Color, Sound, Quantity, Touch, Smell, Movement, Emotion are considered.

During the training period, the participants are memorized the information by considering the above factors. They are practiced several times in remaining sessions. The reward (extrinsic motivation) is included. These sessions aim the participants to apply the principles of good working memory.

Finally, the following visual-spatial memory games are tested and practiced based on the 'CVAC'.

Session (1) – Symmetry
Session (2) – Color Challenge
Session (3) – Right Square
Session (4) – Shopping List
Session (5) – Find the new
Session (6) – Risky Road

Moreover, the researcher introduces the participants with the concept map or mind map. With the head of the researcher, the information people want to memorize creates a mind map and memorize. In this session, the participants are given pieces of information and made them create his or her concept map. Creating concept map is one of the methods making good memory. After each week of the training, one of the participants followed the instructions and involved actively in this programme was also rewarded.

Discussion

In this research, a working memory test was developed to measure middle school students' working memory level. The test items were analyzed systematically by applying the classical test theory (CTT) analysis. In CTT, items were compared according to the characteristics (item difficulty, item discrimination, reliability).

For item difficulty, the mean of item difficulty was 0.61 which means that the result was in moderate index. This result in line with theory from Miller (2008), who stated that most test developers recommend 0.30 to 0.70 difficulty range with an average item difficulty.

For item discrimination, the result was 0.41 means that item discrimination power was in satisfying index. This result supported by Kubiszyn and Borich (2006), who stated that item discrimination should be at least 0.30. After related the finding and the theory, the researcher concluded that this working memory test was acceptable as test items with high discrimination power because the index was in positive value and the index still 0.41 (Pradana et al., n.d.).

The reliability of test items in the working memory test for middle school students covered several aspects. According to the internal consistency value, the findings showed 0.88 means that test items already good for measuring working memory and mark as reliable test reliability.

The good test reliability starts from index 0.70 until 0.90 and above. Thus, it is concluded that the interpretation is reliable test.

In observing the students' working memory, some of the students have high working memory level. But most of students have moderate level and nearly one third of the students have low level. Thus, to improve their working memory level, the researcher develops a working memory programme. This strategies programme was in line with Wilson's Research. In his research, several strategies were applied by several researchers. Macaulay used Association (Macaulay & Cree, 1999); Alloway, Chunking (Alloway, 2009); Zambo (2006), Visualization respectively (McNamara, 2001). Thus, the researcher assumes that the programme in this study was suitable for training middle school students' working memory.

Conclusion

For the test construction, item difficulty, item discrimination and reliability already showed good index and so, the test items were valid enough in order to use in measuring middle school students' working memory.

Working memory is a system responsible for providing the temporary storage and manipulation required for any mental process. Thus, the role of working memory cannot be neglected in teaching-learning process. By knowing students' working memory level, the teacher can train their students by applying memory strategies to improve working memory. Systematically used, middle school students' working memory will be higher and higher in some degree. To sum up, in this paper, a working memory test for middle school students was developed and explored their working memory level. And then, a strategies programme was also developed. However, the test has some limitations. The sample was selected from Magway Region and so, participants from other Regions and States in Myanmar should be chosen for further research.

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References

Alenezi, D. F. (2008). A study of learning mathematics related to some cognitive factors and to attitudes. Ph.D, Thesis, University of Glasgow.

Alloway, T. P. (2009). Working memory in children with developmental disorders.42(4), 372–382. https://doi.org/10.1177/0022219409335214

Backman, A., & Truedsson, E. (1967). Computerized working memory training in group and the effects of noise – A Randomised pilot study with 7 to 9 year old children. In Angewandte Chemie International Edition, 6(11), 951–952.

Baddeley,A.D. (1992). Working memory. Science,255(5044),566–559.https://doi.org/10.1126/ science.1736359

Baddeley, A. D. (2000). The episodic buffer: A new component of working memory? Trends in Cognitive Sciences, 4(11), 417–423. https://doi.org/10.1016/j.apm.2016.02.027

Batt, K., Shores, E. A., & Chekaluk, E. (2008). The effect of distraction on the word memory test and test of memory malingering performance in patients with a severe brain injury. Journal of the International Neuropsychological Society, 14(6), 1074–1080. https://doi.org/10.1017/S135561770808137X

Carter, P. (2009). Memory tests. In Test and Assess Your Brain Quotient (pp. 177–179). Vinod Vasishtha for Kogan Page India Private Limited, 4737/23 Ansari Road, Daryaganj, New Delhi 110 002.

Clay, B. (2001). Is this a trick question? A short guide to writting effective test questions. Kansas Curriculum Center.

Corsi, P. M. (1972). Human memory and the medial temporal lobe region of the brain. In Psychology, McGill University, Montreal.

Fulcher, G., & Davidson, F. (2007). Language testing and assessment. In An Advanced Resource Book. Routledge. https://doi.org/10.1016/s0346-251x(02)00022-2

Gathercole, S. E., & Alloway, T. P. (2007). Understanding working memory- A classroom guide. Harcourt Assessment, 1–22. http://psychology.dur.ac.uk/research/wm/index.htm

Grant.(2011).Theoretical models of working memory.22–49.https://www.maxwell.vrac.puc-rio.br/26568/ 26568_3.PDF

Greub, B. L., & Suhr, J. A. (2006). The validity of the letter memory test as a measure of memory malingering: Robustness to coaching. Archives of Clinical Neuropsychology, 21(4), 249–254.

Holmes, J. (2012). Working memory and learning difficulties. In Dyslexia Review (pp.7–10). https://doi.org/ 10.1007/BF02359148

Johnstone, A. H. (1984). New stars for the teacher to steer by? Journal of Chemical Education, 61(10), 847–849. https://doi.org/10.1021/ed061p847

Macaulay, C., & Cree, V. E. (1999). Transfer of learning: concept and process. Social Work Education, 18(2),183–194

McNamara, D.(2001).Working memory capacity and strategy use. Memory and Cognition, 29(1),10–17.https://doi.org/10.3758/BF03195736

Miller, G. A. (1956). The magical number seven, plus or minus two: some limits on our capacity for processing information. The Psychological Review, 2(63), 81–97. https://doi.org/10.1037/0033-295x.101.2.343 Miller, P. W. (2008). Measurement and teaching. Patric W. Miller and Associates.

Newby, T. J. (1991). Classroom motivation: Strategies of first-year teachers. Journal of Educational Psychology, 83(2), 195–200.

Pascual-Leone, J., & Smith, J. (1969). The encoding and decoding of symbols by children: A new experimental paradigm and a neo-Piagetian model. Journal of Experimental Child Psychology, 8(2), 328–355.

Pickering, S. J. (2006). Working memory and education. Academic Press.

Pradana, H., Sutapa, G., & Suhartono, L. (n.d.). An analysis on validity and reliability of test items in pre-national examination test SMPN 14 pontianak. In Tanjungpura University (pp. 1–8).

Truedsson, E., & Strohmayer, S. (2010). Working Memory Training - theory and practice (pp. 1–96). https://doi.org/10.1097/ccm.0000000000003172

Zambo, D. M. (2006). Students meet Wilfred Gordon. Teaching Exceptional Children, 39(1), 24–27.