DEVELOPMENT OF INSTRUMENT FOR HIGH SCHOOL STUDENTS' READING LITERACY AND NUMERATION ON THERMOCHEMICAL MATERIAL

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ABSTRACT

The aim of this research is to produce a minimum competency assessment instrument (MCA) on thermochemical material that meets the test criteria that is suitable for measuring students' reading literacy and numeracy in terms of validity, reliability, level of difficulty and distinguishing power. The research design used is a development and validation design. The participants involved in this research were high school students at one of the high schools in Bandung City as respondents and validators consisting of 3 lecturers and 2 teachers in their fields. The product resulting from this research is the MCA test instrument on thermochemical material which consists of 5 reading literacy questions and 15 numeracy questions. This test instrument was declared valid based on content validity and based on empirical validity, 16 questions were valid and 4 questions were invalid. The reliability test results showed that the reliability value for the objective questions was 0.73, while the reliability value for the description questions was 0.77 and both were declared reliable. The results of the MCA instrument competency level analysis show that students' reading literacy and numeracy competencies are included in the basic category and require special intervention with a refractive index of 1.53 and 1.00.

Keywords: literacy, numeracy, reading, thermochemistry

INTRODUCTION

The Minimum Competency Assessment (MCA) is a replacement evaluation for the National Examination (NE) which is carried out every year by the government. This replacement is aimed at encouraging improvements in the quality of learning in Indonesia. So far, it is known that the learning abilities of students in Indonesia based on the results of the Program for International Student Assessment (PISA) implemented by the Organization for Economic Co-Operation and Development (OECD) show results that are still low compared to other Asian countries. Between 2003 and 2018, Indonesia enrolled many more 15-year-olds in secondary education without sacrificing the quality of the education provided (Pisa, 2019).

Based on this, the Ministry of Education and Culture (Asesmen, 2020) in 2021 officially implemented the Minimum Competency Assessment (MCA) and the National Examination (NE) is no longer treated.

The Minimum Competency Assessment (MCA) is used to measure students' reading literacy and mathematics literacy (numeracy). These two literacies are very important, because they are fundamental competencies needed by students regardless of profession and future aspirations (Asesmen, 2020). Apart from that, literacy and numeracy skills are also related to making wise decisions in students' lives. The MCA set by the government is one part of the government's target to prepare students to face the 21st century, namely having critical thinking, communication, collaboration and creativity skills (Andiani dkk., 2021). The MCA questions will adapt the Program for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) questions, because the results of the MCA in the long term are expected to have an impact on increasing the abilities and competitiveness of Indonesian students at the international level. The PISA and TIMSS questions that will be adapted to MCA are questions that require students' critical thinking skills and Higher Order Thinking Skills (HOTS).

Research related to the development and validation of MCA has not been carried out much because MCA research is still relatively new being carried out in 2021, there are only a few studies related to the field of chemistry, namely research conducted by Nabilatunnisa & Siswaningsih, 2021, which discusses the Implementation of Minimum Competency Assessment in Acid-Base Material in Scientific Contexts (Zakiyyah, 2022), which discusses the Development of Reading Literacy and Numeracy Minimum Competency Assessment Instruments in Stoichiometry Material, and research conducted by (Nabilatunnisa & Siswaningsih, 2021), which discusses the Implementation of a Minimum Competency Assessment with Ethnoscience Content in Electrolyte and Non-Electrolyte Solution Material. Based on these findings, an MCA instrument needs to be developed in other chemical materials that can link chemical concepts with calculations.

Thermochemical material contains concepts and calculations that require students' understanding in solving problems by thinking critically (Erna et al., 2018). In addition, thermochemistry is a concept that is very close to events in everyday life so it is hoped that students will find it easier to train their reasoning skills. The thermochemical material in basic competencies 3.4 and 3.5 is suitable to be used as content and context in developing and measuring students' reading literacy and numeracy. Based on all the explanations above, it is

necessary to develop how is the impact of MCA instruments for reading literacy and numeracy for high school students on thermochemical material.

METHODS

The research design used is a development and validation design. The participants in this research were five experts in the field of education and chemistry (consisting of three lecturers and two teachers) as validators and 30 class XII high school students at one of the high schools in Bandung City as respondents in the limited trial of the MCA instrument. The research process began with the planning stage, namely, carrying out an analysis of Basic Competency (KD) for chemistry in high school, analysis of thermochemical material, and a literature study regarding the Minimum Competency Assessment (MCA) framework literature for reading literacy and numeracy. Meanwhile, the development stage is the creation of instrument grids and the creation of Minimum Competency Assessment (MCA) instrument questions containing reading literacy and numeracy on Thermochemistry material. At this stage, the results of the initial draft of the instrument will be validated by 5 expert validators. Finally, the testing and data analysis stage includes testing the MCA instrument by analyzing the data using empirical validity tests, reliability tests, difficulty level tests, and distinguishing power.

RESULTS AND DISCUSSION

Content Validity

The content validity of this research was obtained from the validation results by asking for consideration from validators, namely five experts in the fields of education and chemistry, consisting of three lecturers and two teachers. A total of 23 questions were validated based on two aspects, namely, suitability between the text and the question items and suitability between the indicators of the question items and the question items. Based on the results of content validation, the CVR (Content Validity Ratio) value was obtained. The CVR value is calculated based on the Lawshe (1975) equation. Judging from the number of validators, namely five people, the minimum CVR value with a one-party test significance level of 0.05 is 0.763 (Wilson et al., 2012). Based on the CVR value, for each MCA question item that was developed, 21 questions were declared valid, although there were several question items and reading texts that were declared "Valid*", which means corrections (revisions) were needed to be made to the question items or reading texts. And for questions that are declared invalid, no corrections will be made and the questions will not be used.

Empiric Validity

Empirical validity is validity determined from the results of field trials. The trial was carried out on 30 students. In Arikunto (2021), internal validity can be seen from the results of the correlation coefficient between the question score items and the total test score. Calculations are carried out using the Pearson's Product Moment correlation technique. Based on the empirical validity test carried out, the results showed that 16 questions were declared valid and 4 questions were declared invalid. The empirical validity analysis criteria was according to Arikunto, 2021 and showed by Table 1.

Table 1. The Empirical Validity Analysis Criteria

Question Nomber	Score	Criteria
8	0.80 - 1.00	Very high validity
1, 2, 3, 4, 5	0.60 - 0.79	High validity
6, 7, 9, 11, 9, 11, 12, 13, 17, 18, 19	0.40 - 0.59	Sufficient validity
10, 14	0.20 - 0.39	Low validity
15, 16, 20	0.00 - 0.19	Very low validity

Reliability

The purpose of a reliability test is to determine the extent to which a measuring instrument being developed has consistency with the results obtained in different tests. The reliability value was measured using the Kuder Richardson 20 (KR-20) coefficient for multiple choice, matching and short answer form questions with a score of 1, while for complex multiple choice and description form questions with a maximum score of 2, the Cronbach Alpha coefficient was used.

As a result of the trial, the reliability value obtained using Kuder Richardson 20 (KR-20) for multiple choice, matching and short form questions with a score of 1 was obtained with a value of 0.73, while the reliability value using Cronbach Alpha was 0.77. A measuring instrument that has high reliability means measurements carried out repeatedly with this test on the same subject under the same conditions will produce the same or close to the same information (Firman, 2013). Based on theory according to Frankel (2012) that a standard test has a minimum reliability coefficient of 0.70 (>0.70). If we look at the interpretation of the reliability value of the test instrument in this trial, according to Doran (1980) it can be

categorized into medium reliability criteria because it is in the value range of 0.70-0.80. Meanwhile, according to Bhatnagar et al., (2014), the Cronbach Alpha criteria, reliability values in the range $0.7 \leq \alpha < 0.9$ are declared reliable in the good category. These results show that the instrument on thermochemical material developed meets a good test in terms of its reliability because according to Wallen & Fraenkel (2013), a standard test has a minimum reliability coefficient of 0.70 so that the test is said to meet the reliability requirements.

Difficulty Level

The aim of measuring the level of difficulty of the questions is to find out information on the level of difficulty of the questions and how proportional the difficulty index is for each question in the test being developed. From the results of the difficulty level test on the instrument, there were four questions that had an easy level of difficulty, namely numbers 1, 2, 9, and 17, while the other sixteen questions had a medium level of difficulty; and there are no questions that are included in the difficult category.

According to Daryanto (2014), good questions are questions that are not too easy or not too difficult or questions that have a difficulty index of 0.30-0.70, meaning that good questions are questions that have a medium level of difficulty. In this case, based on limited trials, 16 questions were considered good questions because they had a difficulty index in the range of 0.30-0.70 or had a medium level of difficulty. However, four questions number 1, 2, 9, and 17 have an easy level of difficulty, but this does not mean that these questions should not be used because it goes back to the purpose of the test, as explained by Daryanto, 2014, namely that the questions are too easy or too Difficult doesn't mean it can be used, this depends on the use. This is different from what Arifin (2012) stated, namely if a question has a balanced (proportional) level of difficulty then it can be said that the question is good. However, based on the results of the analysis of the level of difficulty obtained, the questions on the MCA instrument developed were disproportionate because there were no questions that had a difficulty level in the difficult category.

Differentiating Power

The purpose of measuring this discriminating power is to find out the extent to which each question item can differentiate between upper group students and lower group students. This distinguishing power test is divided into two, namely for questions with a score of 1 and for questions with a maximum score of 2, then students are divided into upper groups and lower groups, each amounting to 50% of the total number of students.

Based on the results of the differentiating power test on each MCA question item, there are four questions that have poor differentiating power, namely, question items number 9, 15, 16, and 20; three questions with good enough criteria, namely, questions number 2, 7, and 19; one question item with good criteria, namely, question number 1; twelve questions with very good criteria, namely, questions number 3, 4, 5, 6, 8, 10, 11, 12, 13, 14, 17, and 18.

Arifin (2012) explained that the higher the discriminating power index of a question item, the more capable the question item is of differentiating students who have mastered the competency from students who have not or lacked mastery of the competency. Based on the discriminating power index obtained, the overall or average discriminating power value is 0.38 with good criteria, so that the MCA instrument developed is generally able to differentiate the abilities between upper and lower group students well, but there still needs to be improvements to the questions. for questions with poor and sufficient criteria. Question items that are unable to differentiate students' abilities are likely because the distracting factors are not functioning (Ratnawulan & Rusdiana, 2014).

Reading Literacy Competency Level

Reading literacy is the ability to understand, use, evaluate, reflect on various types of written texts to develop individual capacity as Indonesian citizens and global citizens and to be able to contribute productively to society (Asesmen, 2020). Competency levels in reading literacy are grouped into four groups which describe different levels of competence, namely, advanced, proficient, basic, and requiring special intervention (Asesmen, 2020). The following is a graph of the percentage of students' reading literacy competency levels on thermochemical material.

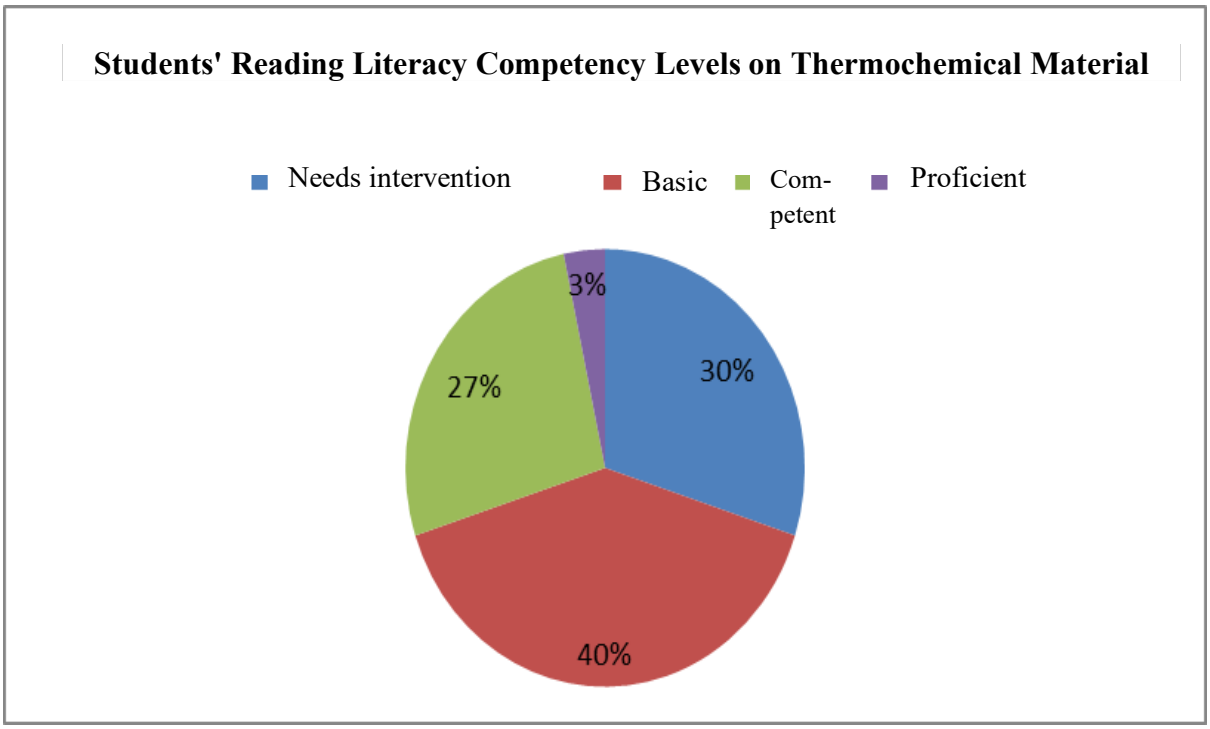

Figure 1. Percentage Graph of Students' Reading Literacy Competency Levels on Thermochemical Material.

Based on Figure 1, it can be seen that as many as 30% of the 30 students or as many as 9 students who are included in the reading literacy competency level group need special intervention; 40% or 12 students fall into the basic reading literacy competency level group; 27% or 8 students are included in the proficient reading literacy competency level group and 3% or 1 student is included in the proficient group.

Table 2. Bias Index of Students' Reading Literacy on Thermochemical Material

Competency Level	Student Percentage	Weight	Index	
A	B	c	b*c	Total
Proficient	3% (0.03)	3	0,09	
Master	27% (0.27)	2	0,54	1,53
Basic	40% (0.40)	1,5	0,60	
Need Intervention	30% (0.30)	1	0,3	

Based on Table 2, it can be concluded that the level of students' reading literacy competency in thermochemical material is grouped at the "Basic" competency level.

Numeracy Competency Level

Numeracy is the knowledge of skills to use various kinds of numbers and symbols related to basic mathematics to solve practical problems in various contexts of daily life and analyze information displayed in the form of tables, graphs, charts, etc. (Kebudayaan & Pendidikan, 2017). Competency levels in reading literacy are grouped into four groups which describe different levels of competence, namely, advanced, proficient, basic, and requiring special intervention (Asesmen, 2020). Figure 2 is a graph of the percentage of students' numeracy competency level in thermochemical material.

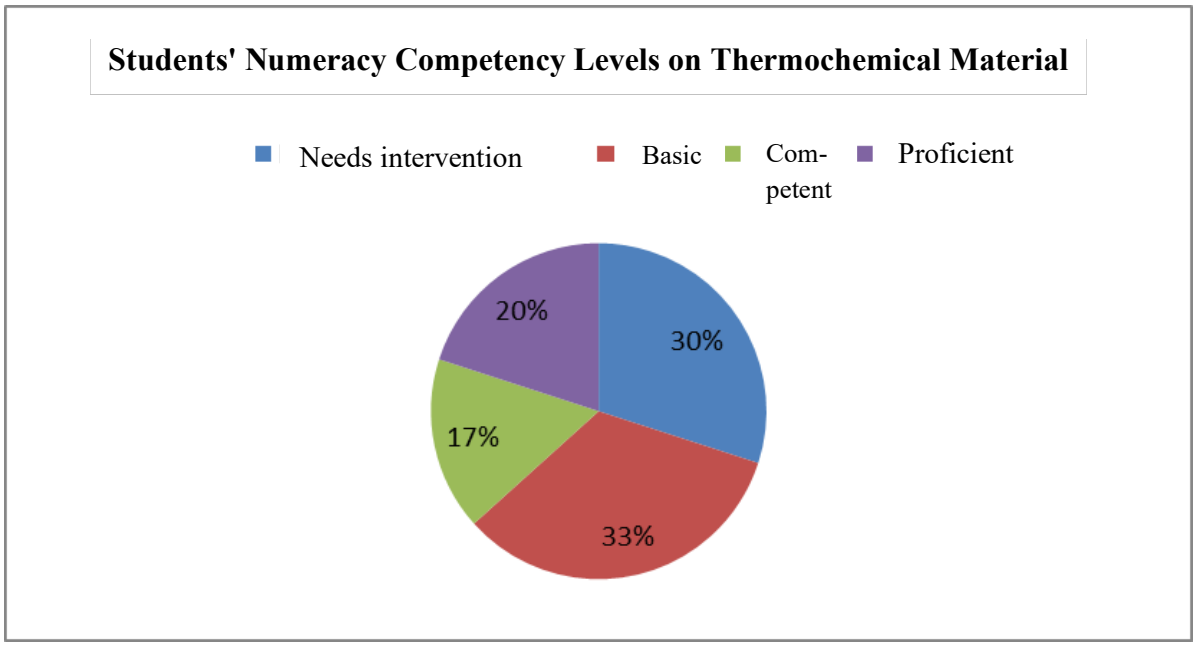

Figure 2. Percentage Graph of Students' Numeracy Competency Levels on Thermochemical Material.

Based on the diagram above, it can be seen that as many as 30% of the 30 students or as many as 9 students who are included in the numeracy competency level group need special intervention; 33% or 10 students fall into the basic numeracy competency level group; 17% or 5 students are included in the proficient numeracy competency level group and 20% or 6 students are included in the proficient group.

Table 3. Student Numeracy Bias Index on Thermochemical Material

Competency Level	Student Percentage	Weight	Index	
A	B	c	b*c	Total
Proficient	20% (0.2)	3	0,6	1.735
Master	17% (0.17)	2	0,34	

Competency Level	Student Percentage	Weight	Index	
A	B	c	b*c	Total
Basic	33% (0.33)	1,5	0,495	
Need Intervention	30% (0.30)	1	0,3	

Based on Table 3, it can be concluded that the level of student numeracy competency in thermochemical material is grouped at the "Needs special intervention" competency level.

Analysis of Reading Literacy and Numeracy Skills

Students' ability levels are categorized into 3 criteria, namely high, medium and low (Arikunto, 2021). The criteria are explained that if a student's score is greater than 21, they are in the high category. Students with scores between 9 and 21 are in the medium category. Meanwhile, student scores of less than 9 are in the low category.

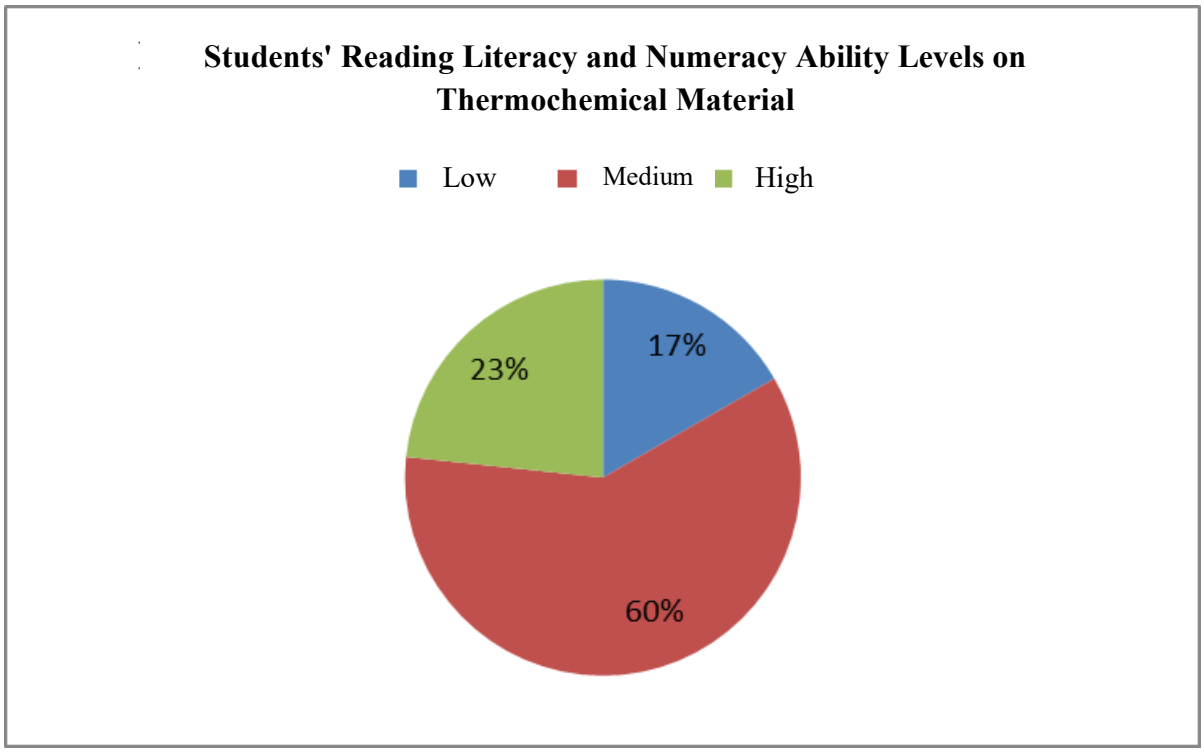

Figure 3. Percentage Graph of Students' Reading Literacy and Numeracy Ability Levels on Thermochemical Material.

Based on Figure 3, it can be seen that as many as 5 students or 17% of the 30 students have low reading literacy and numeracy skills because they only got a score of less than 9. Students with medium abilities, namely 60% or 18 students, were only able to get a score between 9 and 21. And students with high abilities, namely 23% or 7 students, were able to get a score of more than 21. It can be seen that the level of students' reading literacy and numeracy

skills in thermochemical material is at the medium criteria, which indicates that the majority of students have the ability to determine or retrieve explicit information. contained in the text as well as simple interpretations.

CONCLUSION

Validity of the MCA instrument for reading literacy and numeracy in the developed thermochemical material. It was found that 20 questions were declared valid based on the content validity test and 16 questions were declared valid and 4 questions were declared invalid based on the results of the empirical validity test. Meanwhile, the reliability of the MCA instrument for reading literacy and numeracy on the developed thermochemical material is 0.73 with medium criteria for questions with a maximum score of 1, while for questions with a maximum score of 2 the reliability test results obtained are 0.77 with a good category, with These results can be stated that the 20 MCA questions that were developed were reliable or acceptable. The level of difficulty of the MCA instrument for reading literacy and numeracy in the thermochemical material that was developed was, namely, 4 questions in the easy criteria and 16 questions in the medium criteria and without any criteria questions. hard.

The level of student reading literacy competency resulting from the implementation of MCA on thermochemical material showed that 9 students were grouped into reading literacy competency levels requiring special intervention, 12 students were at the basic level, 8 students were at the sufficient level, and 1 student was at the advanced level. Based on this, it can be concluded that the level of students' reading literacy competency in thermochemical material is grouped at the "Basic" competency level with a refractive index of 1.53.

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