MathCityMap-Assisted Case-Based Learning with a Realistic Mathematics Education Approach to Improve Mathematical Literacy Reviewed from Adversity Quotient

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***Abstract*—Mathematical literacy is one of the most important skills in the 21st century. However, according to PISA data, mathematical literacy in Indonesia is still low. Low mathematical literacy makes it difficult for students to solve mathematical problems. This issue arises from various factors, both internal and external. One internal factor is how students react to and overcome difficulties, this capability is called Adversity Quotient (AQ). External factors include the quality of learning and the supporting media utilized. So models and media are needed that can support these capabilities. This study evaluates the quality of a MathCityMap assisted CBL model with an RME approach in enhancing mathematical literacy and examines AQ's role in it. Two sample classes, an experimental group and a control group, were selected through cluster random sampling from the population of grade VII students at SMPN 20 Semarang. Two subjects from each AQ category were selected through purposive sampling to describe mathematical literacy based on AQ. The developed model effectively enhances students' mathematical literacy, as shown by the results of the right one-part two mean difference test of n-gain values, $t_{count} = 7.071 \geq t_{1-\alpha,dk} = 1.997$ was obtained, H_0 rejected, it can be concluded that there is a difference in the enhance students' mathematical literacy average, with the experimental class showing higher literacy levels than the control class, experimental class n-gain $= 0.528 > 0.320 =$ control class n-gain. Both fall within the category of moderate improvement. In addition, based on the results of the test examining the influence of AQ on mathematical literacy and the description of mathematical literacy in relation to AQ, it can be concluded that AQ positively influences mathematical literacy—the higher a student's AQ, the greater their mathematical literacy. The relationship between AQ and the MathCityMap-assisted CBL model with the RME approach is to support learning with relevant and realistic cases.**

***Keywords*—mathematical literacy, case-based learning, MathCityMap, adversity quotient**

I. Introduction

Science and technology are advancing rapidly in the 21st century. In particular, educational technology is evolving at an unprecedented pace, continuously adapting to new developments and innovations. Teachers and students are challenged with the need to master a variety of competencies, collectively called 21st-century learning skills (21-C) [1–4]. The 21-C learning skills refer to the umbrella concept that includes a series of learning that society needs to fully participate in this era as workers and citizens [5]. Specifically, 21-C learning skills focus on seven skills, namely collaboration, communication, creativity, critical thinking, literacy, problem-solving, and socio-emotional skills [6].

One of the most important and related skills is mathematical literacy [7, 8]. Mathematical literacy is the ability to formulate, apply, and understand mathematics in diverse contexts. It involves using mathematical reasoning to describe, explain, and predict phenomena through mathematical concepts, methods, facts, and tools [9–12]. Mathematical literacy enables individuals to grasp the significance of mathematics in the world and make logical decisions and judgments that responsible, involved, and thoughtful citizens require.

An individual must be equipped to embrace their role as a lifelong learner, capable of independently acquiring knowledge. They should also be prepared to tackle real-world challenges that require the practical application of skills and competencies gained through both formal education and everyday experiences [13–15]. Mathematical literacy is able to help a person to understand the role of mathematics in daily life and help in analyzing, reasoning, and communicating ideas effectively related to problem solving encountered in daily life [16]. Because of its significance, mathematics literacy is an essential component of the competences that students at all educational levels need to acquire [17–19]. Efforts to enhance mathematical literacy are essential, both through the use of effective learning models and the integration of suitable media. Before selecting the appropriate model and media, it is crucial to first consider the components of mathematical literacy to ensure clarity in learning outcomes.

According to PISA 2022, the components of mathematical literacy include mathematical processes, content, and context. The process component describes the actions an individual takes to address a problem within a given situation. The content component refers to the mathematical concepts and tools utilized for problem-solving. Lastly, the context component highlights the real-life scenarios in which the problems occur. The process component involves the steps of formulating a problem mathematically; using concepts, facts, procedures, and reasoning; interpreting, applying, and evaluating the results of a mathematical process [20]. The components of mathematical literacy can be seen from the Mathematics Framework contained in the Fig. 1.

However, mathematical literacy in Indonesia is still relatively low. This is evidenced by the 2022 PISA survey data, Indonesia's mathematical literacy only reaches level 2 by 18%, significantly lower than the average in OECD countries of 69% [21]. This shows that Indonesia's mathematical literacy is much lower than that of other

countries. The poor mathematical literacy of Indonesian pupils has also been noted in a number of earlier studies [22–24].

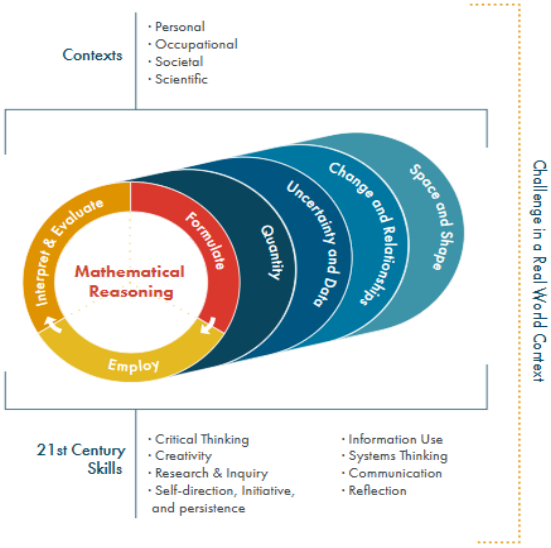

Fig. 1. PISA 2022 mathematics framework [21].

In the case of low mathematical literacy, students have difficulty solving mathematical problems. A students reaction to adversity determines whether it will result in their enjoyment, development, and success or in disappointment, sadness, and despair [25–27]. There is an ability to face difficulties called Adversity Quotient (AQ). Like Intelligence Quotient (IQ), AQ also has an important role for a person. With a high Adversity Quotient, one can easily overcome the existing hurdles. AQ is the ability to handle difficulties or a measure of human resilience [28–30]. Stoltz posited that a person with a higher AQ score is more successful in their work and personal life. In addition to being a measure of job success, AQ has the ability to forecast and impact every facet of human potential and performance.

There are four dimensions that measure an individual's AQ including Control, Possession, Range, and Endurance, which is the CORE model. The Control Dimension measures control, as perceived by the individual, over side effects; Origin and Possession measures what or who a person sees as the origin of an adverse situation and how much he sees himself responsible for the same; The Reach dimension measures the spillover effect of adversity to other areas of one's life, i.e. whether or not the consequences of the current adversity will affect aspects of the lives of others; The Durability dimension is the time span in which a person expects difficulties to last for a long time [25, 31–33].

AQ is very important in the scope of education. It is now a crucial idea in both schooling and human resource management [29]. There was a lot of interest in AQ when it was first presented, particularly in the realm of education. Numerous research and investigations have demonstrated that a person's performance is influenced by both their resilience and capacity to overcome obstacles in addition to their intelligence and skill [25, 29, 34]. Limited research has been conducted on the challenges associated with intelligence difficulties. AQ is positively related to emotional intelligence and other intelligences [35]. Other studies have linked intelligence difficulties to academic achievement [36, 37], achievement motivation [38], social skills [39], work performance, stress [40], and leadership skills [41].

Based on this, AQ (Adversity Quotient) and mathematical literacy are essential skills for the 21st century. To foster these abilities, it is crucial to utilize appropriate media and learning models that align with the demands of the modern era. One such model is the MathCityMap-Assisted Case-Based Learning (CBL) approach. CBL has a positive influence and can improve mathematical literacy [42–44]. This is in accordance with the concept of student AQ, where CBL provides learning that starts from relevant and interesting cases, which spurs students to be more active in learning [45, 46]. So that students are more trained in managing difficulties. In addition, many educational institutions have used various technologies in their educational environments over the last decade to improve teaching and learning processes [47]. The use of learning media is very important in supporting learning with CBL. One of the things that can be integrated is MathCityMap. Several studies have stated that MathCityMap has a positive influence and can improve mathematical literacy [48–50].

Based on the description above, mathematical literacy is an essential skill for students. To enhance mathematical literacy, the Case-Based Learning (CBL) model can be implemented. Moreover, fostering mathematical literacy in line with 21st-century requirements involves incorporating digital media into the learning process. One such digital tool is MathCityMap. Additionally, mathematical literacy should be supported by appropriate learning approaches, such as the Realistic Mathematics Education (RME) approach. Furthermore, other factors, such as Adversity Quotient (AQ), are believed to influence mathematical literacy. Based on the above background, this study evaluates the quality of a MathCityMap assisted CBL model with an RME approach in enhancing mathematical literacy and examines AQ's role in it.

II. Literature Review

A. Mathematical Literacy

Mathematical literacy as the knowledge to know and use basic mathematics in daily life [14]. The meaning of the definition means that a person has good mathematical literacy if someone has the ability to know the basic mathematical knowledge used to solve a problem in daily life. Mathematical literacy as an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. It assists individuals to recognise the role that mathematics plays in the world and to make the well-founded judgements and decisions needed by constructive, engaged, and reflective citizens [51]. As a result, having knowledge of mathematical literacy becomes important, as people with these skills not only understand mathematics but also use it effectively to cope with complex situations [52]. Mathematical literacy has unique characteristics that are different from substantive mathematics. Mathematics in schools focuses on substantive content, while math literacy focuses on how to use mathematics in real life [10].

Thus, when faced with real problems related to

mathematics, individuals can use their mathematical literacy abilities to choose the right strategy in solving them [53, 54]. This is in line with [55] who stated that the mathematical literacy possessed by students is not only an understanding of mathematics, but is able to use it in solving problems in daily life. Mathematical literacy also forces individuals to communicate and explain a problem that is being faced with the use of mathematical concepts [56, 57]. Having mathematical literacy skills is very beneficial for students, because having good mathematical literacy skills makes it easier to solve problems and makes it easier to solve problems in daily life mathematically, it is necessary to prepare students to face problems in facing real life [58]. In addition, the application of mathematical literacy can help improve students' ability to apply mathematical concepts [55].

In this study, the test used is a mathematical literacy test based on the topic of rectangular and triangle similarity. The questions used are made based on mathematical literacy indicators, communication, mathematising, representation, reasoning and argument, devising strategies for solving problems, using symbolic, formal, and technical language and operations, and using mathematical tools [59].

B. *Case-Based Learning*

Essentially, the Case-Based Learning (CBL) model is an educational approach closely aligned with the Problem-Based Learning (PBL) model, as both present contextual problems for learners to solve [60]. CBL is a derivative of PBL so it has similar characteristics. The main characteristic of CBL derived from PBL is that the given problem/case is used to stimulate and support the acquisition of knowledge, attitudes, and skills. The most prominent difference that distinguishes CBL and PBL is that in analyzing cases in learning with the CBL model, students are given the opportunity to know the core domain of a knowledge and students are encouraged to look for other domains of knowledge that are relevant to the problem in the given case [61]. Students are required to use the material that has been discussed previously to solve and overcome problems in a given case [60]. In other words, CBL requires prior knowledge that can help in case resolution, whereas PBL does not require prior experience or knowledge relevant to the subject matter.

CBL is a Project- and Problem-Based Learning model, where students are subjects and have to deal with clinical cases related to learning objectives [62]. CBL is defined as an educational approach that integrates theory and practice through authentic cases to foster diagnostic skills and promote student-centered learning [63, 64]. CBL is a teaching strategy that requires students to actively participate in problem scenarios that simulate real-world situations and the field they are learning [65]. CBL is a student-centered learning model that actively involves students in learning through the use of scenarios or case studies [66, 67]. n the learning process, students are encouraged to explore, identify problems, and solve cases provided under the guidance of the teacher during instructional activities. This method fosters increased student motivation, satisfaction, and active participation in learning [68, 69]. The syntax used in learning with the CBL model is (1) case is establish, (2) case is analysed by groups, (3) brainstorming, (4) formulate learning objectives, (5) dissemination of new findings, (6) group shares results, and (7) identify areas for improvement & integrated into clinical practice [60].

C. *MathCityMap*

The MathCityMap (MCM) project, established at Goethe University of Frankfurt, offers users a web portal with a graphical user interface (GUI) to access a database of math path tasks and routes. Additionally, it provides a smartphone app (available for iOS and Android) that organizes this data into a mobile path guide [49, 70]. A math trail is a collection of questions designed by an individual to form a series of tasks, which are then utilized in an online or digital classroom setting [48, 71]. MathCityMap is a technology-driven platform comprising two key components: a web portal and a smartphone application [50]. The MathCityMap web portal enables users to create and view math assignments and paths using GPS data. Meanwhile, the MathCityMap smartphone application, available for Android and iOS, assists students in completing assignments along the math paths created via the portal [72] (Fig. 2).

Fig. 2. View of MathCityMap through web portal (left) and smartphone application (right).

MathCityMap offers flexibility for teachers to tailor it as a

learning tool by aligning it with the material being taught. Teachers can design stop points or tasks, then compile them into trails, resulting in math trails. These trails can be integrated with customized learning models. Using the web portal, teachers create math trails, while students access and complete assignments via the MathCityMap app, available on the Google Play Store. Students are guided to observe objects at specific locations and solve tasks directly based on the provided directions.

D. Adversity Quotient

Adversity Quotient (AQ), often referred to as the science of resilience, evaluates an individual's ability to cope with and overcome life's challenges [25]. AQ is the intelligence in processing difficulties and turning them into new challenges to learn and solve [73, 74]. AQ can be an indicator to see how strong a person can continue to survive a problem he is facing [28]. This AQ is a very important psychological and emotional factor and must be strengthened for students to have in addition to mathematical intellectual competence in learning activities [74]. Numerous research and investigations have demonstrated that a person's performance is influenced by both their resilience and capacity to overcome obstacles in addition to their intelligence and skill [25, 29, 34].

In this study, Adversity Quotient (AQ) refers to students' ability to overcome learning challenges, as defined by Stoltz's theory. According to this theory, AQ is categorized into three types: quitters (low AQ), campers (medium AQ), and climbers (high AQ) as shown in Table 1. The research instrument utilized in this study is the Adversity Response Profile (ARP), based on Stoltz's standard ARP, which has been translated for this purpose. However, after going through validation, the ARP questionnaire was considered too difficult for students to understand. Therefore, the author revised the questionnaire according to the instructions of the validator but still referred to the standard ARP.

Table 1. AQ category based on ARP [29, 75]

Score	Kategory	Type
<59	Very Low	Quitter
60–94	Low	
95–134	Medium	Camper
135–165	Hight	Climber
166–200	Very Hight	

III. Materials and Methods

A. Research Design

This study employs a mixed-method, incorporating a quantitative research method to evaluate the quality of learning with the MathCityMap-assisted CBL model with the RME approach to students' mathematical literacyand employs a qualitative research method to describe mathematical literacy based on the Adversity Quotient (AQ) of Grade VII students at SMPN 20 Semarang.

The CBL model follows William's syntax. Initially, students are presented with realistic cases accompanied by case-solving sheets based on the concept of rectangular and triangle similarity. They are then guided to solve five additional pre-arranged cases outdoors. Using MathCityMap, students navigate the trail and locate problem points (tasks), importing the results of their observations through the platform. They measure the observed objects directly, based on the coordinates provided by MathCityMap. Following this, students disseminate their observation findings and present them in class. Finally, teachers reinforce the students' results to consolidate their learning.

Before being used to measure students' mathematical literacy and AQ, validity and reliability tests were conducted. In this study, the type of validity used is expert validity. The validity calculation uses the following formula, with the validity criteria shown in Table 2.

$$validity\ score = \frac{expert\ validity\ mean}{maximal\ score} \times n\ criteria$$

Table 2. The validity criteria

Score	Criteria
$1.00 \leq x < 1.80$	Very Invalid
$1.80 \leq x < 2.60$	Invalid
$2.60 \leq x < 3.40$	Quite Valid
$3.40 \leq x < 4.20$	Valid
$4.20 \leq x < 5.00$	Very Valid

The recapitulation of the results of the validation of research instruments is presented in Table 3.

Table 3. Research instrument validation recapitulation

Score	Score	Criteria
Mathematical Literacy Pre-test	4.75	Very Valid
Mathematical Literacy Post-test	4.79	Very Valid
Adversity Respone Profile	4.69	Very Valid

Based on Table 3, it can be concluded that each instrument's score meets the very valid criteria, indicating that the prepared instrument is appropriate and valid for use in research.

Reliability testing was conducted using the Cronbach's Alpha formula, selected due to the test format, which included descriptive questions and questionnaires.

$$r = \left(\frac{n}{n-1}\right)\left(1 - \frac{\sum s_i^2}{s_t^2}\right)$$

r = the reliability coefficient, n = the number of items, s_i^2 = the variance of every items, s_t^2 = the variance of total scale.

In this study, a reliability test was conducted on the mathematical literacy test instrument and ARP through instrument testing. The instrument was tested on 33 seventh-grade students. A summary of the reliability results for the research instrument is provided in Table 4.

Table 4. reliability results recapitulation

Score	Reliability Coefficient	Criteria
Mathematical Literacy Pre-test	0.678	Reliable
Mathematical Literacy Post-test	0.785	Reliable
Adversity Respone Profile	0.869	Reliable

Based on Table 4, it can be concluded that all research instruments meet the criteria for reliability.

B. Sample and Data Collection

Data were collected from Grade VII students at SMPN 20 Semarang, Indonesia. Therefore, the population of this study includes all Grade VII students at SMPN 20 Semarang. The sampling technique employed in this study is cluster random sampling, where two out of seven classes are selected at random. Each class is homogeneous, without superior classes, which facilitates the researchers' analysis of learning quality. To assess improvements in mathematical literacy, pre- and post-test instruments are utilized in both classes, each of which receives different treatments. The class samples taken were class VII G for the experimental class and VII H for the control class. In the experimental class, learning is conducted using the MathCityMap-assisted CBL model with the RME approach, whereas the control class follows the Problem-Based Learning (PBL) model.

In addition, the experimental class was instructed to complete an Adversity Quotient (AQ) questionnaire using the Adversity Response Profile (ARP) to evaluate the influence of AQ on mathematical literacy within the MathCityMap-Assisted CBL model with the RME Approach. After analyzing the influence of AQ on mathematical literacy in the experimental class, two subjects from each AQ type-quitter, camper, and climber-were selected to describe mathematical literacy based on their respective AQ types. The selection of subjects was conducted using purposive sampling, as the subjects were chosen based on the criteria established by the researcher. The subjects of the study are identified using initials to facilitate data analysis while adhering to research ethics.

C. Analyzing of Data

Good learning quality is characterized by effective interactions between students, teachers, and learning resources within a conducive learning environment to achieve learning objectives. The quality of learning is assessed based on three stages: (1) the planning stage, (2) the implementation stage, and (3) the assessment or evaluation stage. The planning stage is considered to be of good quality if the instruments and learning tools are valid and meet the minimum required criteria. The implementation stage is considered to be of good quality if the teacher's observations meet at least good criteria and the students' responses are positive. The evaluation stage is considered to be of good quality if the outcomes of the MathCityMap-assisted CBL model with the RME approach demonstrate effectiveness.

Meanwhile, qualitative data analysis is conducted using the results of mathematical literacy tests for each AQ research subject. Based on the data collected, an AQ test was administered using an ARP to the thirty-three sample students. "Based on their AQ test scores, participants were categorized into three groups according to their AQ levels: climbers, campers, and quitters. Student AQ is categorized into three levels—climbers, campers, and quitters—based on the scoring categorization method provided by [29] in Table 5. Subsequently, participants were administered a mathematical literacy test.

The students' AQ scores and mathematical literacy results were analyzed using a regression test to examine the influence of AQ on mathematical literacy. "Two subjects from each category were selected for a comprehensive interview. The data analysis stage involved the processes of grouping, reducing, presenting, and hypothesizing the outcomes derived from the in-depth interviews and tests [76]. "Triangulation was employed to evaluate the reliability of the data by comparing information obtained from in-depth interviews and algebraic thinking tests.

Table 5. Distribution of participants based on ARP scores

Total number of participants	Adversity Quotient		
	Climber	Camper	Quitter
33	6	23	4

IV. Result and Discussion

A. Quality of Learning

The quality of learning using the MathCityMap-assisted CBL model with the RME approach to enhance mathematical literacy is assessed through three stages: planning, implementation, and evaluation. The planning stage is considered high-quality if the learning tools and research instruments are valid and meet the minimum required criteria. The implementation stage is deemed effective if observations of the MathCityMap-assisted CBL model with the RME approach meet at least good criteria and if students' responses to the model are generally positive. Finally, the evaluation stage is regarded as successful if the outcomes demonstrate the effectiveness of the MathCityMap-assisted CBL model with the RME approach.

Before conducting research, the planning stage is the initial phase undertaken by researchers. The learning planning stage is the stage before the research is carried out, where the preparation of learning tools and research instruments to be used is carried out. The learning tools are designed to align with the curriculum applied to both the experimental and control classes. These tools include learning outcomes (CP), learning objectives (TP), the flow of learning objectives (ATP), teaching modules, teaching materials, and student worksheets (LKPD), all prepared for four meetings. The preparation of instruments for this study includes an Adversity Quotient questionnaire (using the Adversity Quotient Response Profile) along with its grid; Mathematics Literacy Test Questions accompanied by the grid, answer key, and scoring guidelines; a teacher activity observation sheet (LPAG); a student response sheet (LRS); interview guidelines; and non-verbal observation sheets.

Based on Table 6, all learning instruments and devices were deemed to be of very high quality. This is further evidenced by the average score of 4.75. Before being used to measure students' abilities, the pre-test and post-test instruments were validated and tested for reliability. It was found that all items in the pre-test and post-test were valid with high criteria. Furthermore, using Cronbach's Alpha formula, it was found that $r_{count} = 0.6785 > r_{table} = 0.349$, indicating that the test items are reliable and fall under the 'moderate reliability' category. Based on the validity and reliability results, the learning instruments and tools are deemed suitable for use in the learning process of this study.

Table 6. Recapitulation of validation results of learning devices and research instruments

	Component	Validation Result		Average	Criteria
		Validator 1	Validator 2		
1.	Learning Outcomes	4.50	5.00	4.75	Very Good
2.	Learning Objectives	4.50	5.00	4.75	Very Good
3.	Flow of Learning Objectives	4.50	5.00	4.75	Very Good
4.	Teaching Modules	4.54	4.92	4.73	Very Good
5.	Teaching Materials	4.59	4.91	4.75	Very Good
6.	Student Worksheets (LKPD)	4.57	4.86	4.71	Very Good
7.	Instrument Pretest	4.50	5.00	4.75	Very Good
8.	Instrument Posttest	4.57	5.00	4.79	Very Good
9.	Adversity Quotient Respone Profile	4.50	4.88	4.69	Very Good
10.	Teacher Activity Observation Sheet	4.63	5.00	4.81	Very Good
11.	Student Response Sheet	4.57	5.00	4.79	Very Good
12.	Interview Guidelines	4.56	5.00	4.78	Very Good
13.	Non-Verbal Observation Sheets	4.50	4.88	4.69	Very Good
	Average			**4.75**	**Very Good**

The next stage is the implementation of learning using the MathCityMap-assisted CBL model with the RME approach, following William's modified syntax, which consists of: (1) presenting a case, (2) collecting relevant information, data, and supporting sources for case resolution, (3) solving the case, (4) concluding and presenting the results, and (5) verifying the answers. The MathCityMap is integrated into the second and fifth stages of the syntax, serving as a medium to facilitate outdoor learning in solving realistic cases. This aligns with the principles of Realistic Mathematics Education (RME), which include guided re-invention, progressive mathematization, didactical phenomenology, and the use of self-developed models.

In the implementation of learning, the preliminary activities conducted by the researcher included preparing the class with opening routines, such as greeting the students and asking a student representative to lead the prayer. Next, the researcher checked student attendance. The activity then proceeded with an introduction to the material, where the researcher explained that, in daily life, many aspects are related to flat structures. Examples include their application in the fields of construction, contracting, building, and even agriculture, such as in rice fields, among others. The researcher continued by explaining the competencies to be achieved. Students were guided to recall concepts related to angles, lines, and flat shapes. The learning objective—understanding and explaining the properties of triangles and squares—was then communicated to the students. Following this, the researcher introduced the MathCityMap application and outlined the learning activities that would be conducted using it. Students were instructed to install and open the MathCityMap app. Upon successfully opening the app, students could select 'Add Trails' from the menu and input the trail code provided by the researcher. They then downloaded the trail to facilitate their learning. The menu display, input code, and trail description are presented in Fig. 3.

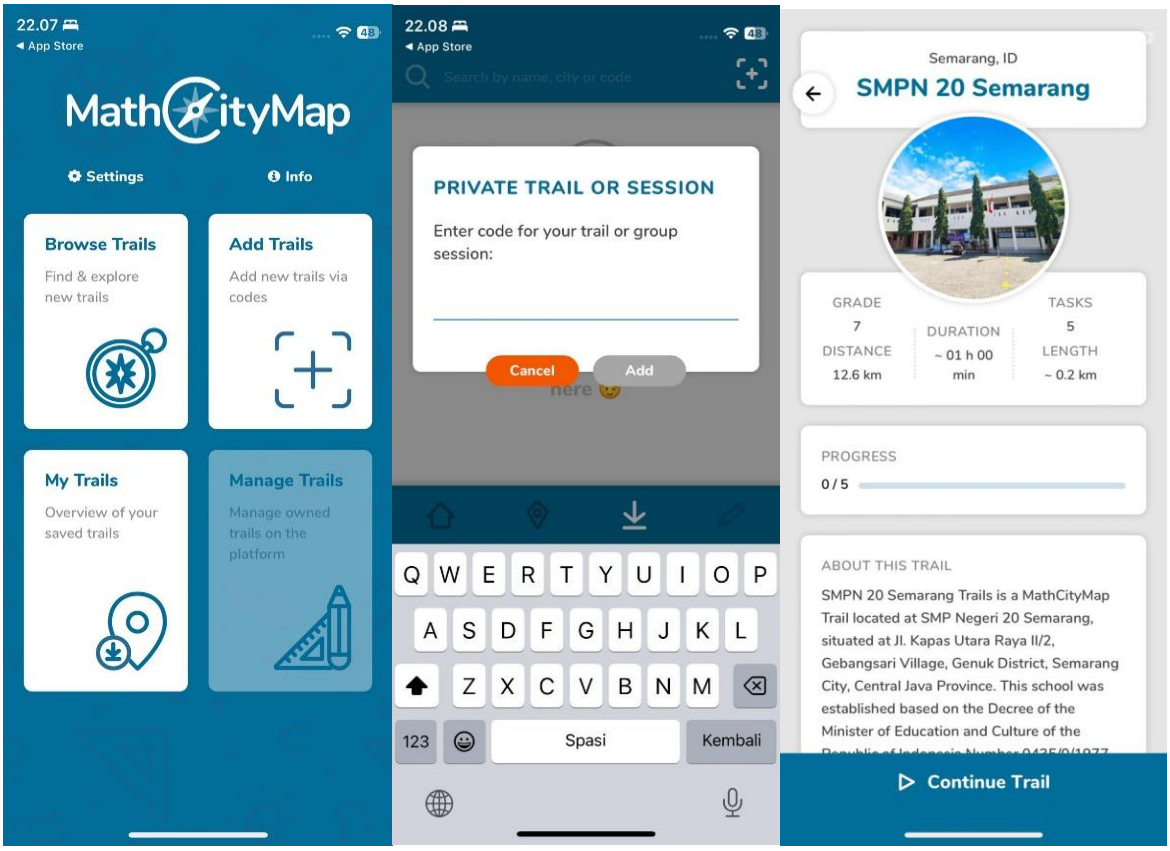

Fig. 3. Menu display, input code, and trails description on MathCityMap.

The first core activity in the MathCityMap-assisted CBL model with the RME approach involves presenting a case. At this stage, students are divided into groups of 5–6 members based on their Adversity Quotient (AQ) categories. The researcher then introduces contextual cases drawn from the surrounding environment. Students listen to the explanation of the case, seek clarification if needed, and record relevant information. Additionally, the researcher explains that the task requires students to compile a report based on the activities conducted, utilizing the provided LKPD.

The second stage in the MathCityMap-assisted CBL model with the RME approach focuses on gathering information, data, and resources to support case resolution. At this stage, students analyze a given case, devise strategies to resolve it, and seek relevant information, data, and resources from teaching materials, the internet, or other learning tools. Additionally, students formulate problems by drawing upon their prior knowledge and considering concepts aligned with the principles of the RME approach, including intertwining, progressive mathematization, and didactical phenomenology.

The third stage in the MathCityMap-assisted CBL model with the RME approach involves solving the case. At this stage, learning is conducted outdoors, where students use the MathCityMap app to address the provided cases. With the aid of mathematical tools, students solve these cases and document their results on the LKPD sheet, emphasizing interactivity and the self-developed model. Students identify the points where the problems are located and prioritize which points to address first. They then analyze and understand the given questions before beginning to solve them. By performing direct measurements, students are able to answer the questions based on the concepts they already possess. Using the information, data, and resources available to them, students resolve the cases under the teacher's guidance, emphasizing the principle of guided re-invention. The display of MathCityMap usage is illustrated in Fig. 4.

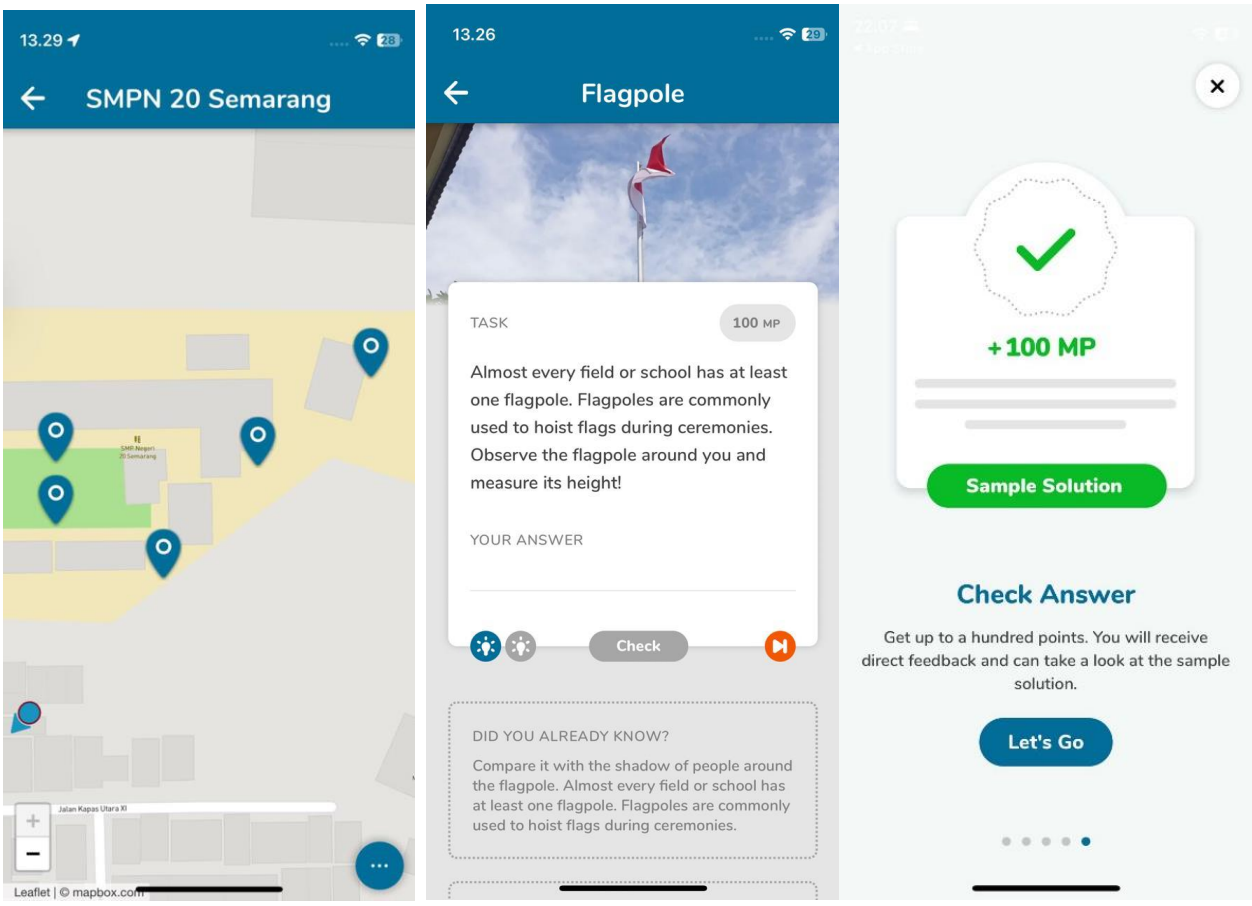

Fig. 4. Trails view, questions, and check answers.

The fourth stage of the MathCityMap-assisted CBL model with the RME approach involves concluding and presenting. During this stage, student groups summarize their findings and draw conclusions from the case-solving process. The researcher then selects a group categorized as AQ climbers, based on the best results, to present their findings. The climber group delivers their presentation, after which the other groups engage by asking questions about the results presented.

The fifth stage of the MathCityMap-assisted CBL model with the RME approach involves verifying the answers. During this stage, the researcher reinforces the results of the group presentations and provides clarification in cases of errors related to the case resolution. Students are encouraged to ask questions to address any remaining uncertainties. The researcher acknowledges the efforts of all students and provides information about assignments through MathCityMap. These tasks are designed to enable students to solve problems in alignment with the processes and indicators of mathematical literacy. Additionally, the researcher shares details about the material to be studied in the next session and concludes the learning activities with greetings.

The implementation of learning has generally been conducted in accordance with the prepared teaching modules. All learning materials across the meetings were delivered, and all stages of the MathCityMap-assisted CBL model with the RME approach were successfully implemented. This is supported by the results of observations on teacher activities

and student responses. Observations of teacher activities were conducted to evaluate the alignment of classroom learning with the prepared teaching modules. Additionally, a student response questionnaire was administered to assess their perceptions and feedback on the conducted learning process. Learning is considered to be of high quality if the assessment of teacher activities in the MathCityMap-assisted CBL model with the RME approach is categorized as at least 'good,' and student responses to the model are similarly categorized as at least 'good'.

Table 7. Learning implementation observation assessment results

Learning to-	Score	Criteria
1	4.76	Very Good
2	4.84	Very Good
3	4.92	Very Good
4	4.84	Very Good
Average	4.84	Very Good

Based on Table 7, the average score of 4.84 indicates that the researcher's activities as teachers in the MathCityMap-assisted CBL model with the RME approach fall within the 'very good' category.

Student response questionnaires were administered during the second and fourth meetings in the class employing the MathCityMap-assisted CBL model with the RME approach, involving a total of 33 students. The responses were analyzed using average scores. Based on the analysis, the average score for the second meeting was 4.14, while the fourth meeting showed an improvement with an average score of 4.32, both of which fall into the 'good' category. Moreover, student responses demonstrated improvement in the fourth meeting, as supported by individual assessments showing that over 80% of students were categorized as 'very good.' These findings indicate a positive student response to the MathCityMap-assisted CBL model with the RME approach.

Based on the results of the two assessments of learning implementation—teacher observations and student responses to the learning process—it is classified under the 'very good' criteria. Therefore, it can be concluded that the assessment or evaluation of the learning implementation stage conducted by the researchers as teachers aligns with the learning objectives and meets the 'very good' criteria.

The third stage is the learning evaluation stage, which aims to assess the effectiveness of the MathCityMap-assisted CBL model with the RME approach in improving students' mathematical literacy. The assessment is based on five indicators of learning effectiveness, namely: (1) the average mathematical literacy of students with MathCityMap-assisted CBL model with RME approach reaches the criteria of completeness based on the average scores of BTA and KKN, (2) the proportion of classical completeness of mathematical literacy of students with MathCityMap-assisted CBL model with RME approach $\geq 75\%$ based on the average scores of BTA and KKN, (3) the average mathematical literacy of students with MathCityMap-assisted CBL model with RME approach is higher than the average mathematical literacy of students with problem-based learning model, (4) the proportion of classical completeness of students' mathematical literacy with MathCityMap-assisted CBL model with RME approach is higher than the proportion of classical completeness of students with problem-based learning model, and (5) the average increase in mathematics literacy reaches the criteria of completeness based on the average scores of BTA and KKN with MathCityMap-assisted CBL model with RME approach is higher than the average increase in mathematical literacy of students with problem-based learning model.

The initial mathematical literacy test (pretest) and the final mathematical literacy test (posttest) were used as assessment tools in this study. The results of the pretest and posttest of mathematical literacy were utilized to evaluate the quality of learning in the MathCityMap-assisted CBL model with the RME approach. Below is an analysis of the pretest and posttest data comparing the mathematical literacy performance of students in the experimental and control classes

B. Preliminary Data Analysis (Pretest)

Preliminary data analysis (pretest) is conducted to determine whether the mathematical literacy abilities of students show a similar average or exhibit only minor differences between the experimental class and the control class. Below are the results presenting the average values of students' mathematical literacy pretest.

Table 8. Mathematical literacy pretest mean score results

Class	Average	SD
Control Class	65.27	5.77
Experiment Class	64.09	4.77

Based on Table 8, it can be observed that the average mathematical literacy of students in the two sample classes prior to the learning treatment is relatively low. The first step in the analysis is the normality test, which aims to determine whether the distribution of the sampled data follows a normal distribution. Based on the output obtained on the calculation results using IBM SPSS 25 Software, the significance value on Kolmogorov-Smirnov for the experimental class is $Sig. = 0.149 > 0.05$ and the significance value on Kolmogorov-Smirnov for the control class is $Sig. = 0{,}061 > 0.05$ so it is known that both values is $Sig. > 0.05$ and H_0 accepted. Thus, it can be concluded that the pretest data on students' mathematical literacy from both the control class and the experimental class originate from a normally distributed population.

The second test is the homogeneity test, which aims to determine whether the research samples used have the same variance. Based on the output obtained from the homogeneity test, conducted using IBM SPSS 25 software, the significance value is $sig. = 0.219 > 0.05$. Therefore, based on the predetermined testing criteria, it can be concluded that H_0 is accepted. Thus, it can be concluded that the pretest data on the mathematical literacy of students in both the control class and the experimental class exhibit the same or homogeneous variance.

The third test is the two-mean similarity test, which aims to determine whether the two samples have a significant difference in their averages. This test is conducted using the Independent Samples T-Test, assisted by IBM SPSS 25 software. Based on the results of the mean similarity test, the significance value on the pretest value of mathematical literacy of the experimental class and control class obtained a value of $Sig.(2 - tailed) = 0.368 > 0.05$, so that based on the testing criteria it can be concluded that H_0 is accepted.

This indicates that the pretest data on the mathematical literacy of the experimental class and control class demonstrate the same average initial values for both sample groups, showing no significant difference. Thus, it can be concluded that, prior to the implementation of the learning treatment, both the experimental class and control class exhibit the same initial level of mathematical literacy.

Based on the pretest results, it was determined that both samples originate from a normally distributed population, exhibit homogeneous variance, and have no significant difference in their average scores. Therefore, classes VII-F and VII-G can be utilized as samples in this study.

C. Final Data Analysis (Posttest)

Analysis of the final data (posttest) is conducted to evaluate the quality of learning using the MathCityMap-assisted CBL model with the RME approach, based on five assessment indicators. The results detailing the average posttest scores of students' mathematical literacy are presented in Table 9.

Table 9. Mathematical literacy posttest mean score results

Class	Average	SD
Control Class	76.72	5.08
Experimental Class	82.90	4.06

Before testing the hypothesis test analysis based on the five indicators above, a prerequisite test is required first, namely the normality test and homogenity test on the posttest data. The results of the normality test based on the output obtained in the IBM SPSS 25 software, obtained the results that the significance value on Kolmogorov-Smirnov for the experimental class is $Sig. = 0.200 > 0.05$ and the significance value on Kolmogorov-Smirnov for the control class is $Sig. = 0.090 > 0.05$. So it is known that both $Sig. > 0.05$ values and H_0 is accepted. This indicates that the data of mathematical literacy posttest scores of the experimental group and control group come from normally distributed populations. Meanwhile, the results of the homogeneity test based on the output obtained on IBM SPSS 25 software, obtained a significance value on the posttest value of mathematical literacy of the experimental class and control class which obtained a value of $Sig. = 1.00 > 0.05$. Therefore, based on the test criteria, it can be concluded that H_0 is accepted. This shows that the data of mathematical literacy posttest scores of experimental and control classes have the same variance or homogeneous.

Based on the posttest results, it was found that the final data on the mathematical literacy of students in both the experimental and control classes originate from a normally distributed population and exhibit homogeneous variance. Before proceeding with the prerequisite test, it is necessary to find the average value of the Actual Completion Limit (BTA) and the Criteria for Achieving Learning Objectives (KKN) to be used later in testing the research hypothesis. After the calculation, the average value of BTA and KKN is 65,818. Furthermore, after the prerequisite test is fulfilled and the average value of BTA and KKN has been sought, it can be continued with the analysis of the final data (posttest) of students' mathematical literacy based on the five indicators of learning quality assessment above.

The first hypothesis test, namely the individual completeness test, utilizes the right one-tailed t-test. It aims to determine whether the average mathematical literacy of students in the experimental class, who received instruction using the MathCityMap-assisted CBL model with the RME approach, has reached the level of individual completeness. This is evaluated based on the Actual Completion Limit (BTA) of the Learning Objective Achievement Criteria (KKN), with a minimum completeness threshold of 65,818. The results of the calculation for the right one-tailed average test are presented in Table 10.

Table 10. Right one-tailed T-test

μ	μ_0	t_{count}	$t_{(0,95),32}$	Criteria	Conclusion
82.898	65.818	21.4696	2.0369	$t_{count} > t_{1-\alpha,dk}$	$\mu > \mu_0$

Based on the calculation results in the right one-tailed average test, the value of $t_{count} = 21.4696 \geq t_{(0.95).32} = 2.0369$ is obtained, so based on predetermined criteria reject H_0. Thus, it can be concluded that The mathematical literacy of students taught using the MathCityMap-assisted CBL model with the RME approach has reached the average values for BTA and KKN.

The second hypothesis test, namely the classical completeness test using the right one-part proportion test (z-test) which aims to test the proportion of experimental class students who get learning with the MathCityMap-assisted CBL model with RME approach obtaining mathematics literacy posttest results that have achieved classical completeness of 75% based on the average value of the Actual Completion Limit (BTA) and the Criteria for Achieving Learning Objectives (KKN). The results of the calculation of the right one-party proportion test or z-test are presented in the Table 11.

Table 11. Right one-part proportion test

π_0	z_{count}	$z_{0,5-\alpha}$	Criteria	Conclusion
0.75	3.3166	1.645	$Z_{count} > Z_{0,5-\alpha}$	H_0 is rejected

Based on the calculation results in the table above, it is known that the proportion (π_0) is 75% or 0.75, and the results of right one-part proportion test obtained $z_{count} = 3.3166 \geq z_{0,5-\alpha} = 1.645$, so that based on the criteria that have been determined, H_0 is rejected. Thus, it can be concluded that the proportion level of students who get learning by using the MathCityMap-assisted CBL model with RME approach who have reached completeness based on the average value of BTA and KKN has reached more than 75% of all experimental class students.

The third hypothesis test, namely the average difference test using the right one-sided two-average test (t-test) which aims to test whether the average posttest of mathematical literacy of students who get learning with the MathCityMap-assisted CBL model with RME approach is better than students who only get learning with the problem-based learning model. The results of the calculation for the right one-sided two-average test are presented in Table 12.

Table 12. Right one-sided two-average test

$\overline{x_1}$	$\overline{x_2}$	t_{count}	$t_{1-\alpha,dk}$	Criteria	Conclusion
82.898	76.292	2.166	1.669	$t_{count} > t_{1-\alpha,dk}$	H_0 is rejected

Based on the right one-sided two-average test, the value of $t_{count} = 2.166$ was found to be greater than $t_{1-\alpha,dk} =$

1.669. Based on this result, the predetermined H_0 is rejected. Therefore, it can be concluded that the average mathematical literacy of students who receive learning through the MathCityMap-assisted CBL model with the RME approach is higher than that of students who receive learning through the PBL model.

The fourth hypothesis test is the proportion difference test using the right one-sided two-proportion difference test (z-test) which aims to test whether the proportion of students who reach the average value of the Actual Completion Limit (BTA) and the Criteria for Achieving Learning Objectives (KKN) on the mathematics literacy test after learning the MathCityMap-assisted CBL model with RME approach is higher than the proportion of students who only get learning with the problem-based learning model. The results of the calculation of the right one-party two-proportion test or z-test are presented in the Table 13.

Table 13. Right one-part two-prportion test

z_{count}	$z_{0,5-\alpha}$	Criteria	Conclusion
2.063	1.645	$z_{hitung} > z_{0,5-\alpha}$	H_0 is rejected

Based on the calculation in the test, the value of $z_{count} = 2.063 \geq z_{tabel} = 1.645$ is obtained so that based on the criteria that have been determined, H_0 is rejected. Thus, it can be concluded that the proportion of students who successfully achieved the average value of the Actual Completion Limit (BTA) and the Criteria for Achieving Learning Objectives (KKN) on the mathematics literacy test after getting a MathCityMap-assisted CBL model with RME approach is higher than the proportion of students who only get learning with a problem-based learning model.

The fifth hypothesis test is the test of the average increase in N-Gain using the N-Gain test followed by the right one-sided mean difference test which aims to test whether the average increase in mathematical literacy of students who take part in learning with a MathCityMap-assisted CBL model with RME approach is higher than the average increase in mathematical literacy of students who only take part in learning with a problem-based learning model. The results of the calculation of the right one-part two mean difference test of N-Gain values are presented in the Table 14.

Table 14. Right one-part two mean difference test of N-gain values

$\overline{x_1}$	$\overline{x_2}$	t_{count}	$t_{1-\alpha,dk}$	Criteria	Conclusion
0.528	0.320	7.071	1.997	$t_{hitung} > t_{1-\alpha,dk}$	$\mu_1 > \mu_2$

Based on the calculation results in the test, the average N-Gain value of the experimental class was 0,528 while the control class was 0,320. The right one-part two mean difference test of n-gain values, $t_{count} = 7.071 \geq t_{1-\alpha,dk} = 1.997$ was obtained, so based on the predetermined criteria reject H_0. Thus, it can be concluded that the average improvement in mathematical literacy among students who participate in learning through the MathCityMap-assisted CBL model with the RME approach is greater than that of students who only engage in learning through the problem-based learning model.

Based on the results of testing the effectiveness of learning, it can be concluded that the use of the MathCityMap-assisted CBL model with the RME approach meets the five indicators of effectiveness. Consequently, at the evaluation stage, this learning model is considered effective, signifying that the learning evaluation stage is of good quality.

Based on these results, it was found that the assessments at the planning stage, implementation stage, and evaluation stage are all of good quality. Therefore, it can be concluded that learning using the MathCityMap-assisted CBL model with the RME approach to improve students' mathematical literacy is of good quality.

D. Effect of Adversity Quotient to Student's Mathematical Literacy

The study found that AQ significantly influenced prosocial behavior, indicating that the null hypothesis was accepted. This hypothesis served as a notable strength and novelty, building upon the findings of prior research. Furthermore, it was assumed that p-values could effectively measure the study's success, a notion that was demonstrated through the results of this research. The level of significance (p) used is $p < 0.01$, which means very significant. Obtain significant value is $0.000 < 0.05$. So H_0 be rejected or accepted H_1. This means that the linear equation or relationship between AQ and students' mathematical literacy in the MathCityMap-assisted CBL model with the RME approach. From the regression test value, obtain significant value is 0.000 < 0.05 was obtained. So H_0 be rejected or accepted H_1. This means that the regression coefficient of the linear regression equation is significant. There is a significant influence between AQ and students' mathematical literacy. The values of $a = 57.091$ and $b = 0.211$ were obtained. So, the regression equation is $\hat{y} = 57.091 + 0.211x$.

This study also seeks to explore the details of AQ's contribution. The practical contribution of this research is aimed at identifying and understanding the extent to which AQ influences students' mathematical literacy. The value of $R^2 = 0.567 = 56.7\%$ was obtained. This score indicates that AQ accounts for 56.7% of the influence on mathematical literacy. In other words, 43.3% of mathematical literacy in the MathCityMap-assisted CBL model with the RME approach is affected by other variables.

E. Description of Mathematical Literacy Reviewed from AQ

1) Climber AQ (subject A-01)

The following are figure of test results and interview excerpts of subject A-01 on the mathematical literacy test questions on shape similarity.

Based on Fig. 5, the subject of AQ of the climber type (subject A-01), answered the question correctly and completely. The test results meet the communication indicators (can state the information known and asked in a complete and accurate manner), mathematising (can convert the information known in the problem into mathematical form), representation (can use images to present data or information correctly and completely according to the problem presented), reasoning and argument (can write down the solution to the problem and give conclusions into real form completely and correctly), devising strategies for solving problems (can determine strategies and use them to solve problems correctly), using symbolic, formal, and technical language and operations (can use formal operations and mathematical symbols to perform calculations), and

using mathematical tools (can use mathematical tools correctly according to the problems presented).

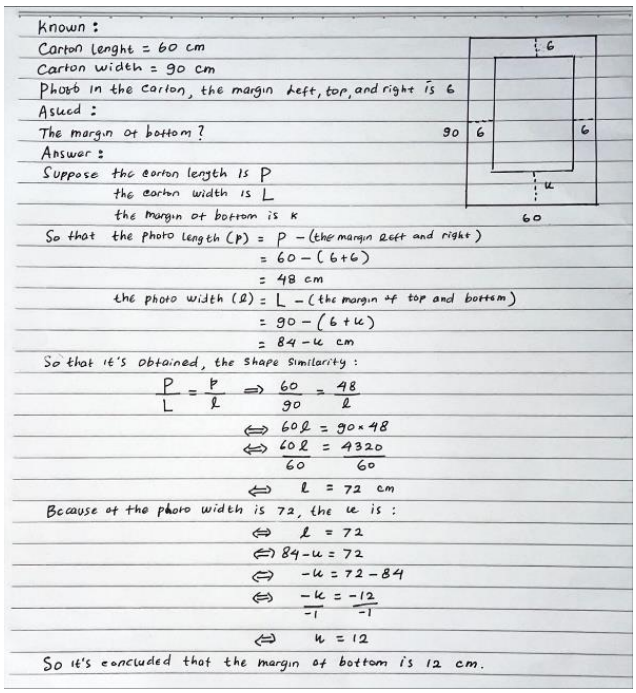

Fig. 5. Mathematical literacy test result from subject A-01.

The subject A-01 answered the interview question, "I wrote down the information that was known and asked first, I assumed that the length of the carton was P and the width of the carton L, while the size of my photo was for example p and l, the width of the bottom side that I would look for was for example k, using the concept of rectangular coherence, I obtained l is 72 so that I can conclude that the value of k is 90–6–72=12, So the width of the bottom side is 12 cm." From the results of the interview, subject A-01 are able to answer interview questions according to what is written on the test sheet. This is reinforced by the expression when answering questions, namely answering clearly, concisely, and without confusion. Triangulation of test methods and interviews concluded that the subject A-01 was able to meet all mathematical literacy indicators.

2) Climber AQ (subject A-02)

The following are figure of test results and interview excerpts of subject A-02 on the mathematical literacy test questions on shape similarity.

Based on Fig. 6, the subject of AQ of the climber type (subject A-02), answered the question correctly and completely. The test results meet the communication indicators (can state the information known and asked in a complete and accurate manner), mathematising (can convert the information known in the problem into mathematical form), representation (can use images to present data or information correctly and completely according to the problem presented), reasoning and argument (can write down the solution to the problem and give conclusions into real form completely and correctly), devising strategies for solving problems (can determine strategies and use them to solve problems correctly), using symbolic, formal, and technical language and operations (can use formal operations and mathematical symbols to perform calculations), and using mathematical tools (can use mathematical tools correctly according to the problems presented).

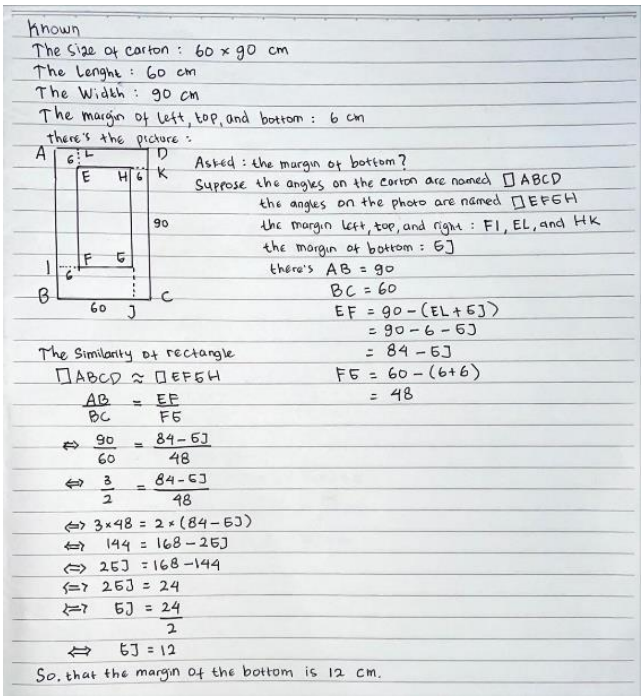

Fig. 6. Mathematical literacy test result from subject A-02.

The subject answered the interview question, "The information I know is that the carton size is 60 x 90 cm and the margin of the photo is 6. I took each corner of the cardboard and photo, namely ABCD and EFGH, the margins of each photo, namely I, J, K, and L. In the question, what was asked was the bottom margin of the photo (GJ). I used the concept of similarity of rectangle. I substituted what I knew into a formula, then I operated it so that I obtained a GJ width value of 12. So, it is concluded that the bottom margin of the photo is 12 cm." From the results of the interview, subject A-02 are able to answer interview questions according to what is written on the test sheet. This is reinforced by the expression when answering questions, namely answering clearly, concisely, and without confusion. Triangulation of test and interview methods concluded that the climber-type AQ subject A-02 was able to meet all mathematical literacy indicators.

3) Camper AQ (subject B-01)

The following are figure of test results and interview excerpts of subject B-02 on the mathematical literacy test questions on shape similarity.

Based on Fig. 7, the AQ subject of the camper type (subject B-01), answered the question in sequence, but there were still some errors. The test results are seen from mathematical literacy indicators, communication (can mention information that is known and asked but is incomplete), mathematising (can convert the information known in the problem into mathematical form), representation (can use images to represent data or information correctly and completely according to the problem presented), reasoning and argument (can write down problem solutions and give conclusions in real form but not yet in line with the problems presented), devising strategies for solving problems (can determine strategies and use them to solve problems correctly), using symbolic, formal, and technical language and operations (can use formal operations and mathematical symbols to perform

calculations), and using mathematical tools (can use mathematical tools correctly according to the problem presented).

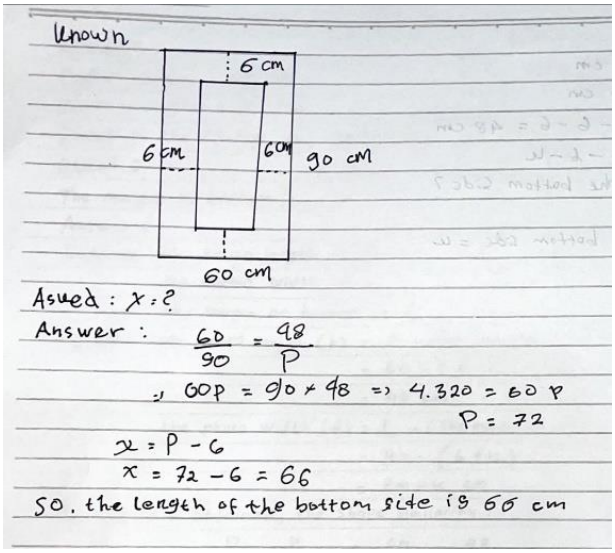

Fig. 7. Mathematical literacy test result from subject B-01.

The subject B-01 answered the interview question, "I describe the information that is known, and write down the information asked and at the same time equate it as x, then I use the concept of quadrilateral coherence, I operate and enter the value that I know so that the p value is obtained which is 72. After that I find the value of x from the result of the p value by subtracting the width of the upper part which is 6 so that I get the value of x, which is 66. So, the length of the bottom side is 66." From the results of the interview, subject B-01 are able to answer interview questions according to what is written on the test sheet. This is reinforced by the expression when answering questions, namely students answering questions with happy faces, but scratching their heads to sign confusion when answering questions, and postures tend to be non-expressive such as hesitating in doing problems. Triangulation of test and interview methods concluded that subject B-01 were less able to meet communication, reasoning and argument, and devising strategies for solving problems, and being able to meet other indicators.

4) Camper AQ (subject B-02)

The following are figure of test results and interview excerpts of subject B-02 on the mathematical literacy test questions on shape similarity.

Based on Fig. 8, the AQ subject of the camper type (subject B-01), answered the question in sequence, but there were still some errors. The test results are seen from mathematical literacy indicators, communication (can mention information that is known and asked but is incomplete), mathematising (can convert the information known in the problem into mathematical form), representation (cannot use images to represent data or information correctly and completely according to the problem presented), reasoning and argument (can write down problem solutions and give conclusions in real form but not yet in line with the problems presented), devising strategies for solving problems (can determine strategies and use them to solve problems correctly), using symbolic, formal, and technical language and operations (can use formal operations and mathematical symbols to perform calculations), and using mathematical tools (cannot use mathematical tools correctly according to the problem presented).

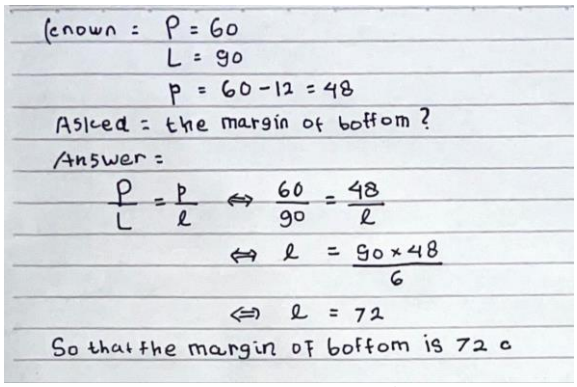

Fig. 8. Mathematical Literacy Test Result from subject B-02.

The subject B-02 answered the interview question, "The information I know is that the length of the carton is 60 cm, the width of the carton is 90 cm, so the length of the photo is 60-6-6=48, what is asked is the bottom margin of the photo. I used the concept of rectangular similarity. I operated and entered the value I knew so that the l value was obtained, which was 72. So, the bottom margin is 72." From the results of the interview, subject B-02 are able to answer interview questions according to what is written on the test sheet. This is reinforced by the expression when answering questions, namely students answering questions with happy faces, but scratching their heads to sign confusion when answering questions, and postures tend to be non-expressive such as hesitating in doing problems. Triangulation of test and interview methods concluded that subject B-02 were not able to representation and using mathematics tools; less able to meet communication, reasoning and argument, and being able to meet other indicators.

5) Quitter AQ (subject C-01)

The following are figure of test results and interview excerpts of subject C-01 on the mathematical literacy test questions on shape similarity.

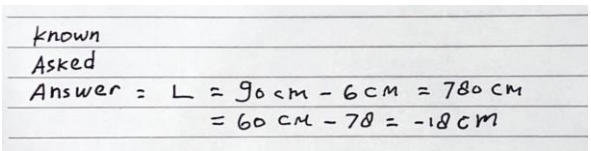

Fig. 9. Mathematical literacy test result from subject C-01.

Based on Fig. 9, the AQ subject of the quitter type (subject C-01) is wrong in answering the question. The test results do not meet the indicators of communication (cannot state the information known and asked completely and accurately), mathematising (cannot convert the information known in the problem into mathematical form), representation (cannot use images to present data or information correctly and completely according to the problem presented), reasoning and argument (cannot write down the solution to the problem and give a conclusion in the form real completely and correctly), devising strategies for solving problems (unable to determine strategies and use them to solve problems correctly), using symbolic, formal, and technical language and operations (unable to use formal operations and

mathematical symbols to perform calculations), and using mathematical tools (unable to use mathematical tools correctly according to the problems presented).

The subject C-01 answered the interview question, "I answered the direct test question by reducing the length of the mat by 6, then I reduced the width by the result." From the results of the interview, the student answered the question, namely with a confused face, this was also seen from the behavior of the student who scratched his head, the student also shook his body to show that he was anxious and could not do the problem. Triangulation of test and interview methods concluded that the subject C-01 were not able to meet all indicators of mathematical literacy.

6) Quitter AQ (subject C-02)

The following are figure of test results and interview excerpts of subject C-02 on the mathematical literacy test questions on shape similarity.

Based on Fig. 10, the AQ subject of the quitter type (subject C-01) is wrong in answering the question. The test results do not meet the indicators of communication (can mention information that is known and asked but is incomplete), mathematising (can convert the information known in the problem into mathematical form), representation (cannot use images to present data or information correctly and completely according to the problem presented), reasoning and argument (cannot write down the solution to the problem and give a conclusion in the form real completely and correctly), devising strategies for solving problems (can determine strategies and use them to solve problems correctly), using symbolic, formal, and technical language and operations (unable to use formal operations and mathematical symbols to perform calculations), and using mathematical tools (unable to use mathematical tools correctly according to the problems presented).

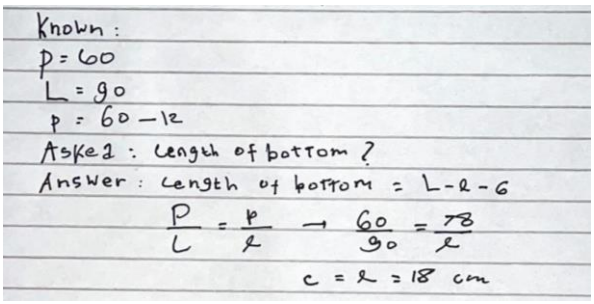

Fig. 10. Mathematical literacy test result from subject C-02.

The subject C-02 answered the interview question, "I know the information is 60 in length, 90 in width, 60-12 in length, what is asked is the width of the bottom. I use rectangular similarity. I got the value of 18 cm." From the results of the interview, the student answered the question with a confused and anxious face, this can also be seen from his behavior of scratching his head and shaking his body which indicates anxiety in answering the question, or it can be said that the subject C-02 cannot do the question. Triangulation of test and interview methods concluded that the quitter-type AQ subjects in subject C-02 were only less able to meet the indicators of communication, mathematising, and devising strategies for solving problems; and are not able to meet other indicators.

Table 15. Mathematical literacy of each subject result

Subject	Indicator						
	1	2	3	4	5	6	7
A-01	A	A	A	A	A	A	A
A-02	A	A	A	A	A	A	A
B-01	B	A	A	B	B	A	A
B-02	B	A	C	B	A	A	C
C-01	C	C	C	C	C	C	C
C-02	B	B	C	C	B	C	C

Table 16. Description of the mathematical literacy

	Code		
	A	B	C
Description	Being able to meet the indicator.	Being underable to meet the indicator.	Being incapable to meet the indicator.

Table 15 shows that subjects with different AQ levels exhibited distinct tendencies in solving mathematical problems. Table 16 shows the differences in students' mathematical literacy based on indicators, including able, underable, and incapable. The climbers subject performs better in solving mathematical literacy problems, successfully meeting all the mathematical literacy indicators. In contrast, the quitters subject performs the worst, as fewer indicators are achieved compared to the camper subject. Students with AQ levels of climber (A-01, A-02) and camper (B-01, B-02) demonstrate the ability to identify known and requested information, as well as effectively convert this information into mathematical forms. In contrast, quitters (C-01, C-02) exhibit less capability in these areas. Climber subjects are able to use images to represent data or information, whereas campers are less capable, and quitters are unable to do so. Climbers can write down solutions to problems and provide real-form conclusions, while B-02 shows less capability, and subjects B-01, C-01, and C-02 are unable to do so. Additionally, climbers are capable of determining strategies and applying them to solve problems, as well as using mathematical tools accurately in relation to the given problems. Campers are less capable in this regard, and quitters are not capable. Lastly, climbers are proficient in using formal operations and mathematical symbols for calculations, whereas campers and quitters demonstrate lower proficiency.

V. Discussion

The MathCityMap-assisted CBL model with the RME approach enhances students' active participation in classroom learning. This method is implemented in groups, with each member assigned a specific role, fostering creativity and motivation among students. This is in line with research from [45] that the use of the CBL model makes students more creative and motivated to learn. This is supported by [46], that students are satisfied because CBL learning is an effective and student-centered learning method, because it involves and motivates students so that it can improve students' knowledge and thinking skills in solving problems. CBL creates more conducive learning activities that make students more enthusiastic and motivated. This is in line with [44], that CBL provides interesting learning activities and has a positive influence on students. This is supported by [42], students are more interested during the learning process when

implementing CBL and students are helped in improving their mathematical literacy. This is in line with research from [43] that learning with the CBL model is effective in improving students' mathematical literacy.

students can actively engage in learning activities while simultaneously enhancing their mathematical literacy skills. Additionally, the use of LKPD (Student Worksheets) has a positive impact, as it helps students better understand and apply mathematical concepts. Providing LKPD questions that are relevant to real-life situations further supports students in making meaningful connections between mathematics and daily life. This is supported by [44], which states that the provision of LKPD helps students apply their mathematical knowledge when encountering similar cases in real-life situations. Case-Based Learning (CBL) emphasizes the process of discovering material concepts independently, enabling students to gain a deeper understanding of the subject. Since comprehension develops through active learning, students take a central role in the learning process, while teachers serve as guides.

The use of MathCityMap as a learning media has a positive impact on students. Activities involving MathCityMap encourage active participation, allowing students to engage with mathematical concepts through environmental exploration linked to real-life cases. This is in line with [77], that the use of MathCityMap can provide active learning activities. This is supported by [48], that its use requires students to be able to explore, assess, interpret, synthesize, and information to produce various forms of learning outcomes. Students' mathematical literacy can also be improved by using MathCityMap on the CBL model. In the going outdoor step, students will be given the opportunity to walk outside the classroom to do tasks cooperatively in a team, which will make a new experience that is very motivating for students. The contextualization of objects within the school environment in Case-Based Learning (CBL) makes problem-solving more accessible for students, as the cases are closely related to their everyday experiences. This connection enhances the meaningfulness of the learning process. Based on the results of learning planning, implementation, evaluation, and discussions supported by previous research, it can be concluded that the MathCityMap-assisted CBL model with the RME approach is of high quality for enhancing mathematical literacy.

In addition, mathematical literacy is also influenced by AQ. Based on the results of the study in the regression test analysis, there was a significant influence between AQ on students' mathematical literacy, with a significance value of $0.000 < 0.005$. The results of this study show that the influence of AQ on students' mathematical literacy is 56.7% and 43.3% is influenced by other factors. Based on the results of the regression analysis, a regression equation was also obtained, namely $y = 57.091 + 0.211x$ where the variable x expressed the student's AQ and the variable y stated the student's mathematical literacy. The value of the constant (a) in the regression equation is positive, then it can be stated that the student's AQ has a positive effect on mathematical literacy. For every increase in one unit of AQ, the mathematical literacy ability will increase by 0.211.

This is in line with the research of [78] which shows a correlation coefficient of 0.620 which shows a very strong and positive relationship between AQ and mathematical literacy. In accordance with the research of [79] that AQ has a significant and positive effect on mathematical literacy skills, and [80], that AQ has an effect of 50.9% on students' mathematical literacy. This is reinforced by [81], that AQ has an influence on the mathematical literacy of students, climber type students in formulating situations mathematically, applying concepts, procedural facts and mathematical reasoning, as well as interpreting, applying and evaluating mathematical results, better than camper and quitter type students. This means that the higher the student's AQ, the higher their mathematical literacy, and vice versa. Climber students will try their best to solve mathematical problems related to mathematical literacy

Further description by the researcher by analyzing the questions by trangulation to each subject based on the type of student AQ. Triangulation of test and interview methods concluded that the climber-type AQ subject A-01 and subject A-02 was able to meet all mathematical literacy indicators. The camper type AQ subjects were less able to meet the indicators. Subject B-01 were less able to meet communication, reasoning and argument, and devising strategies for solving problems, and being able to meet other indicators. Subject B-02 were not able to representation and using mathematics tools; less able to meet communication, reasoning and argument, and being able to meet other indicators. The quitters subject is the worst in solving mathematical literacy problems, because more indicators are not able to be achieved from the camper subject. Subject C-01 were not able to meet all indicators of mathematical literacy. Subject C-02 were only less able to meet the indicators of communication, mathematising, and devising strategies for solving problems; and are not able to meet other indicators. This is in line with the research of [82], climber students can meet the indicators of simplifying a situation or problem so that it is in mathematical form, identify the conditions behind determining mathematical forms, apply mathematical facts and rules when looking for solutions, and explain and justify mathematical results in PISA problems. Likewise in the [83] research, climber-type AQ is able to solve PISA questions up to level 6 well, campers complete up to level 5, and quitters up to level 4.

In the learning process using the CBL model, students with climber-type AQ actively engage in discussions and frequently ask the teacher for clarification when needed. They find the given case challenging, which fuels their enthusiasm to explore the concept of four-dimensional harmony. Students with camper-type AQ also participate in discussions but require encouragement to stay motivated. Meanwhile, students with quitter-type AQ tend to be more passive during discussions, necessitating greater teacher guidance to help them engage in problem-solving and develop an understanding of the concept of revival. The case study gave positive results compared to conventional. First, due to differences in the discussion process, the two groups showed significant differences in type of interaction throughout the project [84]. Second, the learning motivation change patterns of the two groups differed markedly during the project. Third, the more active types of interactions, the more "acceptable" levels of learning motivation, and the more "too low or too high" levels of interactions.

Students with climber-type AQ demonstrate strong determination and put forth their best effort when tackling mathematical literacy tasks. Camper-type AQ students, while capable, often do not fully optimize their efforts. In contrast, students with quitter-type AQ display a tendency toward pessimism, which affects their ability to complete mathematical literacy tasks effectively [53]. During the group observation process, students with climber-type AQ exhibit strong mathematical literacy, as evidenced by their ability to solve cases that meet mathematical literacy indicators. Camper-type AQ students attempt to address mathematical problems related to literacy but do so less effectively. While their mathematical literacy is fairly good, it is not on par with climber students. In contrast, quitter-type AQ students often give up easily when faced with mathematical problems tied to mathematical literacy, resulting in poor mathematical literacy.

In this study, a good relationship was found between the CBL model and the AQ of students. In the CBL model, tudents are challenged to solve cases in accordance with the student's AQ. The higher of AQ, the more challenging students will be to solve cases in learning, so that the mathematical concepts in the climber AQ are higher than those of campers and quitters. Learning with the CBL model makes students more active in learning in the classroom because it is done in groups. This is in line with the research of [43] that learning with the CBL model is effective in improving students' mathematical literacy. Therefore, it can be said that with a high AQ type, students will find it easier to follow learning so that their mathematical literacy increases.

Students with climber-type AQ benefit from consistent habituation provided by teachers, peers, and the environment, as this helps unlock their high potential to improve mathematical literacy. Camper-type AQ students require reinforcement and encouragement from teachers and classmates to boost their enthusiasm in the learning process. Quitter-type AQ students need even more reinforcement than climbers or campers. They also require individualized attention and guidance from teachers as a form of habituation to help them understand and solve problems effectively. This is because AQ has an influence on the mathematical literacy ability of grade VII students of SMP Negeri 20 Semarang by more than 56%, and the rest is influenced by other factors. This is in accordance with [85], that climber students will try their best to solve mathematical problems related to mathematical literacy. Climber students have good mathematical literacy. Camper students will try to solve mathematical problems related to mathematical literacy, but not optimally. Camper students have quite good mathematical literacy, but not as good as the mathematical literacy of climber students. Quitter students are very easy to give up when solving math problems related to mathematical literacy. Quitter students have poor mathematical literacy. The higher the student's AQ, the higher the mathematical literacy [81].

Climber-type AQ students have successfully achieved strong mathematical literacy by fulfilling all components of the mathematical literacy process across six indicators. Camper-type students demonstrate adequate mathematical literacy, meeting two indicators within the formulating process; in the process of applying it is not satisfactory because the subject designs strategies in finding mathematical solutions, applying mathematical concepts in the way of geometric representations and analyzing data but is not optimal when finding solutions so that the results obtained are not right; In the process of interpreting the subject, it is not satisfactory because the results obtained are not related to the context of the problem in the real world, the reasons given by the subject are not logical according to the context of the problem [58]. The mathematical literacy of quitter subjects is still not good because it only meets 2 indicators of the formulation process; in the process of applying did not meet both indicators because the subject did not design a strategy during the process of finding solutions and did not apply the concept appropriately in the way of geometric representation and analyzing data; In the process of interpreting, it does not meet both indicators because it does not reinterpret the results obtained into the context of real-world problems and does not explain the reasoning reasonably related to the answers obtained based on the context of real-world problems.

Based on the results of the AQ influence test on mathematical literacy, as well as the description of mathematical literacy from the perspective of AQ, it can be concluded that AQ has a positive impact on mathematical literacy. The higher a student's AQ, the greater their mathematical literacy. Furthermore, AQ is closely connected to the MathCityMap-assisted CBL model with the RME approach, which serves as a reinforcement tool to support learning through relevant and realistic cases.

VI. Conclusion

The findings of this study concluded that the developed MathCityMap-assisted CBL model with RME approach effectively enhances students' mathematical literacy, as shown by the results of the right one-part two mean difference test of n-gain values, $t_{count} = 7.071 \geq t_{1-\alpha,dk} = 1.997$ was obtained, H_0 rejected, it can be concluded that there is a difference in the enhance students' mathematical literacy average, with the experimental class showing higher literacy levels than the control class, experimental class n-gain $= 0.528 > 0.320 =$ control class n-gain. Both fall within the category of moderate improvement. This is further reinforced by the results of the learning quality evaluation, which indicate: (1) the assessments at the planning stage, all learning instruments and devices were deemed to be of good quality, this is further evidenced by the average score of 4.75, (2) teacher observations and student responses to the learning process are classified under the 'very good' criteria, and (3) the learning evaluation stage is of good quality by meeting the effectiveness of namely: (a) based on the right one-tailed average test, the value of $t_{count} = 21{,}4696 \geq t_{(\mathbf{0,95}),\mathbf{32}} = 2{,}0369$is obtained, it can be concluded that the mathematical literacy of students taught using the MathCityMap-assisted CBL model with the RME approach has reached the average values for BTA and KKN, (b) based on the right one-part proportion test, the value $z_{count} = 3{,}3166 \geq z_{0,5-\alpha} = 1{,}645$, it can be concluded that the proportion level of students who get learning by using the MathCityMap-assisted CBL model with RME approach who have reached completeness based on the average value of BTA and KKN has reached more than 75% of all experimental class students, (c) based on the right

one-sided two-average test, the value of $t_{count} = 2.166 > t_{1-\alpha,dk} = 1.669$, it can be concluded that the average mathematical literacy of students who receive learning through the MathCityMap-assisted CBL model with the RME approach is higher than that of students who receive learning through the PBL model, (4) based on the right one-part two-proportion test or z-test, the value of $z_{count} = 2.063 \geq z_{tabel} = 1.645$, it can be concluded that the proportion of students who successfully achieved the average value of the Actual Completion Limit (BTA) and the Criteria for Achieving Learning Objectives (KKN) on the mathematics literacy test through the MathCityMap-assisted CBL model with RME approach is higher than the proportion of students who receive learning through the PBL model, (5) based on the right one-part two mean difference test of n-gain values, $t_{count} = 7.071 \geq t_{1-\alpha,dk} = 1.997$, It can be concluded that students who engage in learning through the MathCityMap-assisted CBL model with the RME approach demonstrate a greater average improvement in mathematical literacy compared to students who participate in the PBL model.

The results of this study also revealed that AQ positively influenced mathematical literacy in the MathCityMap-assisted CBL model with the RME approach. The regression equation obtained was $\hat{y} = 57.091 + 0.211x$, with a significant influence of 56%. Then, it was described that subjects with AQ of climber (A-01, A-02) and camper (B-01, B-02) are able to mention known and asked information, and are able to convert information into mathematical forms, while quitter (C-01, C-02) is less capable. Climber subjects are able to use images to represent data or information, while campers are less capable, and quitters are not. The climber subject is able to write down the solution to the problem and give conclusions in a real form, while B-02 are less capable, and the subject (B-01, C-01, C-02) are not. Climber subjects are able to determine strategies and use them to solve problems, as well as use mathematical tools correctly according to the problems presented, while campers are less capable, and quitters are not capable. Climber subjects are able to use formal operations and mathematical symbols to perform calculations, while campers and quitters are less able. Based on the results of the AQ influence test on mathematical literacy, as well as the description of mathematical literacy from the perspective of AQ, it can be concluded that AQ has a positive impact on mathematical literacy. The higher a student's AQ, the greater their mathematical literacy. Furthermore, AQ is closely connected to the MathCityMap-assisted CBL model with the RME approach, which serves as a reinforcement tool to support learning through relevant and realistic cases.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

S.M. contributed to the conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, supervision, validation, writing - original draft, and writing - review & editing; F.A. contributed to the conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, software, visualization, writing - original draft, and writing - review & editing; W. contributed to the conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, supervision, validation, and writing - original draft; N.R.D. contributed to the conceptualization, data curation, formal analysis, funding acquisition, methodology, supervision, validation, and writing - original draft; and K.W. contributed to the conceptualization, data curation, funding acquisition, investigation, supervision, validation, and writing - original draft. All authors had approved the final version.

References

[1] K. Ananiadoui and M. Claro, *21st Century Skills and Competences for New Millennium Learners in OECD Countries*, 2009.

[2] E. Laar, A. J. A. M. Deursen, J. A. G. M. Dijk, and J. Haan, "Determinants of 21st-century skills and 21st-century digital skills for workers: A systematic literature review," *Sage Open*, vol. 10, no. 1, 2158244019900176, 2020.

[3] J. Voogt and N. P. Roblin, "A comparative analysis of international frameworks for 21st century competences: Implications for national curriculum policies," *Journal of Curriculum Studies*, vol. 44, no. 3, pp. 299–321, 2012.

[4] G.-J. Hwang, C.-L. Lai, and S.-Y. Wang, "Seamless flipped learning: a mobile technology-enhanced flipped classroom with effective learning strategies," *Journal of Computers in Education*, vol. 2, pp. 449–473, 2015.

[5] M. C. M. Bravo, C. S. Chalezquer, and J. Serrano-Puche, "Meta-framework of digital literacy: A comparative analysis of 21st-century skills frameworks," *Revista Latina de Comunicacion Social*, no. 79, pp. 76–109, 2021.

[6] V. Silber-Varod, Y. Eshet-Alkalai, and N. Geri, "Tracing research trends of 21st-century learning skills," *British Journal of Educational Technology*, vol. 50, no. 6, pp. 3099–3118, 2019.

[7] N. Hayati, B. S. Anggoro, and K. Imama, "The effect of integrating society, science, environment, technology, and collaborative mind mapping (ISSETCM2) model on mathematical literacy in terms of adversity quotient," *Journal of Advanced Sciences and Mathematics Education*, vol. 2, no. 2, pp. 81–88, 2022.

[8] A. Rahman and H. Upu, "Mathematics Literacy Judging from Students' Adversity Quotient of the Tenth Grade at SMAN 1 Takalar," in *Proc. International Conference on Educational Studies in Mathematics (ICoESM 2021)*, Atlantis Press, 2021, pp. 73–78.

[9] O. H. Bolstad, "Lower secondary students' encounters with mathematical literacy," *Mathematics Education Research Journal*, vol. 35, no. 1, pp. 237–253, 2023.

[10] S. Sumirattana, A. Makanong, and S. Thipkong, "Using realistic mathematics education and the DAPIC problem-solving process to enhance secondary school students' mathematical literacy," *Kasetsart Journal of Social Sciences*, vol. 38, no. 3, pp. 307–315, Sep. 2017. doi: 10.1016/j.kjss.2016.06.001

[11] U. Umbara and D. Suryadi, "Re-Interpretation of Mathematical Literacy Based on the Teacher's Perspective," *International Journal of Instruction*, vol. 12, no. 4, pp. 789–806, 2019.

[12] S. Maslihah, S. B. Waluya, and A. Suyitno, "The role of mathematical literacy to improve high order thinking skills," *Journal of Physics: Conference Series*, IOP Publishing, 2020, 012085.

[13] L. M. Rizki and N. Priatna, "Mathematical literacy as the 21st century skill," *Journal of Physics: Conference Series*, IOP Publishing, 2019, 042088.

[14] B. Ojose, "Mathematics literacy: Are we able to put the mathematics we learn into everyday use?" *Journal of Mathematics Education*, vol. 4, no. 1, 2023.

[15] S. A. Hasibuan and K. M. S. M. A. Fauzi, "Development of PISA mathematical problem model on the content of change and relationship to measure students mathematical problem-solving ability," *International Electronic Journal of Mathematics Education*, vol. 15, no. 2, p. em0570, 2019.

[16] A. Muzaki and M. Masjudin, "Analysis of students' mathematical literacy skills," *Mosharafa: Mathematics Education Journal*, vol. 8, no. 3, pp. 493–502, 2019.

[17] L. H. Muhaimin, R. A. Sholikhakh, S. Yulianti, A. Hendriyanto, and S. Sahara, "Unlocking the secrets of students' mathematical literacy to

solve mathematical problems: A systematic literature review," *EURASIA Journal of Mathematics, Science and Technology Education*, vol. 20, no. 4, em2428, 2024.

[18] U. Ic and T. Tutak, "Correlation between computer and mathematical literacy levels of 6th grade students," *European Journal of Educational Research*, vol. 7, no. 1, pp. 63–70, 2018.

[19] P. Yaniawati, D. Fisher, Y. D. Permadi, and S. A. M. Yatim, "Development of mobile-based digital learning materials in blended learning oriented to students' mathematical literacy," *International Journal of Information and Education Technology*, vol. 13, no. 9, pp. 1338–1347, 2023.

[20] Y. Abidin, T. Mulyati, and H. Yunansah, *Literacy Learning: Strategies for Improving Mathematical, Scientific, Reading, and Writing Literacy Skills*, Bumi Aksara, 2021.

[21] *PISA 2022 Results (Volume I)*, PISA, OECD, 2023. doi: 10.1787/53f23881-en

[22] L. M. Thien, I. G. N. Darmawan, and M. Y. Ong, "Affective characteristics and mathematics performance in Indonesia, Malaysia, and Thailand: what can PISA 2012 data tell us?" *Large Scale Assess Educ*, vol. 3, pp. 1–16, 2015.

[23] Zulkardi and R. I. I. Putri, "New school mathematics curricula, PISA and PMRI in Indonesia," *School Mathematics Curricula: Asian Perspectives and Glimpses of Reform*, pp. 39–49, 2019.

[24] K. Komarudin, S. Suherman, and T. Vidákovich, "The RMS teaching model with brainstorming technique and student digital literacy as predictors of mathematical literacy," *Heliyon*, vol. 10, no. 13, Jul. 2024. doi: 10.1016/j.heliyon.2024.e33877

[25] S. Singh and T. Sharma, "Affect of Adversity Quotient on the Occupational Stress of IT Managers in India," *Procedia Comput Sci*, vol. 122, pp. 86–93, 2017. doi: https://doi.org/10.1016/j.procs.2017.11.345

[26] S. Albarika, R. Erlina, and M. Karim, "Pengaruh Adversity Quotient Dan Occupational Stress Terhadap Komitmen Organisasi," *Jurnal Bisnis dan Manajemen (JBM)*, pp. 27–41, 2021.

[27] C. D. Ryff, "Self-realisation and meaning making in the face of adversity: A eudaimonic approach to human resilience," *Journal of psychology in Africa*, vol. 24, no. 1, pp. 1–12, 2014.

[28] P. G. Stoltz, *Adversity Quotient: Turning Obstacles into Opportunities*, John Wiley & Sons, 1999.

[29] X. Wang, M. Liu, S. Tee, and H. Dai, "Analysis of adversity quotient of nursing students in Macao: A cross-section and correlation study," *Int J Nurs Sci*, vol. 8, no. 2, pp. 204–209, 2021. doi: https://doi.org/10.1016/j.ijnss.2021.02.003

[30] M. Fauziah, S. Marmoah, T. Murwaningsih, and K. Saddhono, "The effect of thinking actively in a social context and creative problem-solving learning models on divergent-thinking skills viewed from adversity quotient," *European Journal of Educational Research*, vol. 9, no. 2, pp. 537–568, 2020.

[31] E. S. Phoolka and N. Kaur, "Adversity quotient: A new paradigm to explore," *Contemporary Business Studies*, vol. 3, no. 4, pp. 67–78, 2012.

[32] M. E. E. M. Matore, A. Z. Khairani, and N. Abd Razak, "Development and psychometric properties of the adversity quotient scale: An analysis using rasch model and confirmatory factor analysis," *Revista Argentina de Clínica Psicológica*, vol. 29, no. 5, p. 574, 2020.

[33] M. Effendi, E. M. Matore, A. Z. Khairani, and R. Adnan, "Exploratory Factor Analysis (EFA) for Adversity Quotient (AQ) instrument among youth," *Journal of Critical Reviews*, vol. 6, no. 6, pp. 234–242, 2019.

[34] P.-L. Chin and M.-L. Hung, "Psychological contract breach and turnover intention: the moderating roles of adversity quotient and gender," *Social Behavior and Personality: An International Journal*, vol. 41, no. 5, pp. 843–859, 2013.

[35] T. Kumbanaruk and T. Maetheeponkul, "Adversity Quotient (AQ), Emotional Quotient (EQ) and personality of Chinese businesspeople in Thailand and Chinese business people in China," *Journal of East Asian Studies*, vol. 13, no. 1, pp. 1–18, 2008.

[36] Q. City, *The Adversity Quotient and Academic Performance among College Students at St. Joseph's College, Quezon City*, 2009.

[37] L. D. Canivel, "Principals' adversity quotient: Styles, performance and practices," *Disertasi Tidak Dipublikasikan*, University of Philippines, 2010.

[38] G. A. L. Cornista and C. J. A. Macasaet, "Adversity quotient® and achievement motivation of selected third year and fourth year psychology students of de la salle lipa, ay 2012–2013," *Philippines: De La Salle Lipa, Batangas*, 2013.

[39] M. M. Amparo, "The level of adversity quotient and social skills of student leaders at De La Salle Lipa," Master's Thesis, College of Education, Arts and Sciences, Dela Salle, Lipa, Batangas City, Philippines, 2015.

[40] B. D. Solis and R. L. Elna, "Stress level and adversity quotient among single working mothers," *Asia Pacific Journal of Multidisciplinary Research*, vol. 3, no. 5, pp. 72–79, 2015.

[41] E. Baroa, "Adversity quotient® and leadership skills of school administrators: basis for leadership enhancement program," *Visayas, Philippine: Philippine Normal University*, 2015.

[42] M. I. T. Asfar, A. Asfar, and N. Aspikal, "Effectiveness of Case Based Learning (CBL) accompanied by feedback on students' understanding of concepts," *Journal of Mathematics Education*, vol. 2019, pp. 29–45, 2019.

[43] F. E. Chandra, S. Rahman, D. P. Sari, and L. A. Monalisa, "Development of Case-Based Learning (CBL) tools with the context of traditional ternate cuisine to enhance students' numeracy literacy skills," *AKSIOMA: Journal of Mathematics Education Study Program*, vol. 12, no. 4, pp. 3644–3656, 2023.

[44] V. P. Widyagesti and F. E. Subekti, "Mathematical literacy and students' learning independence at MTs Ell-Firdaus 2 Kedungreja in case-based learning," *Jurnal Karya Pendidikan Matematika*, vol. 10, no. 2, pp. 94–100, 2023.

[45] D. Holden Simbolon, *Pengaruh Model Case Based Learning (CBL) Terhadap Hasil Belajar Mahasiswa*, 2022.

[46] M. Bansal and M. Goyal, "To introduce and measure the effectiveness of case based learning in physiology," *Int J Res Med Sci*, vol. 5, no. 2, pp. 437–445, 2017.

[47] A. M. Mustapha *et al.*, "Students' motivation and effective use of self-regulated learning on learning management system moodle environment in higher learning institution in Nigeria," *International Journal of Information and Education Technology*, vol. 13, no. 1, pp. 195–202, Jan. 2023. doi: 10.18178/ijiet.2023.13.1.1796

[48] B. Sadewo and A. Amidi, "Students' mathematical literacy skills in relation to learning motivation in project-based learning (math trail project) assisted by MathCityMap," in *PRISMA, National Proceeding Conference of Mathematics*, 2023, pp. 162–170.

[49] Z. Lavicza, B. Haas, and Y. Kreis, "Discovering everyday mathematical situations outside the classroom with MathCityMap and GeoGebra 3D," *Research on Outdoor STEM Education in the Digital Age*, WTM, Münster, Germany, 2020.

[50] M. Ludwig and S. Jablonski, "Doing math modelling outdoors—a special math class activity designed with MathCityMap," in *Proc. HEAD'19. 5th International Conference on Higher Education Advances*, Editorial Universitat Politècnica de València, 2019, pp. 901–909.

[51] OECD, "An OECD learning framework 2030," *The Future of Education and Labor*, pp. 23–35, 2019.

[52] Ü. Çakıroğlu, M. Güler, M. Dündar, and F. Coşkun, "Virtual reality in realistic mathematics education to develop mathematical literacy skills," *Int J Hum Comput Interact*, vol. 40, no. 17, pp. 4661–4673, Sep. 2024. doi: 10.1080/10447318.2023.2219960

[53] M. H. P. Pribadi, N. D. S. Lestari, E. Oktavianingtyas, D. Kurniati, and L. A. Monalisa, "Literasi Matematis Siswa SMA dalam Menyelesaikan Soal PISA Ditinjau dari Adversity Quotient," *Jurnal Cendekia: Jurnal Pendidikan Matematika*, vol. 7, no. 3, pp. 2530–2542, 2023.

[54] M. Genc and A. K. Erbas, *Secondary Mathematics Teachers' Conceptions of Mathematical Literacy*, 2019.

[55] A. I. A. Budiyanti, S. Sutrisno, and M. Prayito, "Mathematical literacy skills of eighth-grade students in solving SPLDV problems based on the PISA model, reviewed from the adversity quotient of climbers type," *Imajiner: Mathematics and Mathematics Education Journal*, vol. 4, no. 2, pp. 141–149, 2022.

[56] D. R. Kusumawardani, W. Wardono, and K. Kartono, "The importance of mathematical reasoning in enhancing mathematical literacy skills," in *Prisma, National Proceeding Conference of Mathematics*, 2018, pp. 588–595.

[57] S. Munadi and W. D. R. Febriyanti, "Design and validation of mathematical literacy instruments for assessment for learning in Indonesia.," *European Journal of Educational Research*, vol. 9, no. 2, pp. 865–875, 2020.

[58] A. H. E. Adam, I. Dwijayanti, and D. Endahwuri, "Analysis of the mathematical literacy skills of SMP negeri 1 juwana students in solving mathematical problems, reviewed from the perspective of adversity quotient," *AKSIOMA: Mathematics and Mathematics Education Journal*, vol. 13, no. 2, pp. 213–225, 2022.

[59] *OECD Economic Outlook*, 2021.

[60] B. Williams, "Case based learning—a review of the literature: Is there scope for this educational paradigm in prehospital education?" *Emergency Medicine Journal*, vol. 22, no. 8, pp. 577–581, 2005.

[61] D. P. K. Dayu, V. Rulviana, and R. P. Kurniawati, *Blended Learning with the Case-Based Learning Model in the Implementation of the Merdeka Curriculum*, Cv. Ae Media Grafika, 2022.

[62] H. Arianto and H. N. Fauziyah, "Students' response to the implementation of Case Based Learning (CBL) based hots in junior high school," *INSECTA: Integrative Science Education and Teaching Activity Journal*, vol. 1, no. 1, pp. 45–49, 2020.

[63] J. J. Lim and B. Veasuvalingam, "Does online case-based learning foster clinical reasoning skills? A mixed-methods study," *Future Healthc J*, vol. 12, no. 1, p. 100210, 2025. doi: https://doi.org/10.1016/j.fhj.2024.100210

[64] R. Daly, M. Spooner, G. Offiah, K. Flood, and J. Illing, "Protocol for a realist review of case-based learning in undergraduate medical education," *International Journal of Educational Research Open*, vol. 7, 100366, 2024. doi: https://doi.org/10.1016/j.ijedro.2024.100366

[65] D. N. Syarafina, E. R. Dewi, and D. R. Amiyani, "The Implementation of Case-Based Learning (CBL) as an Innovative Approach to Mathematics Education," in *Proc. the Conference* of *Mathematics and Mathematics Education*, UNY, 2017.

[66] C. Y. Chen, "Flipped classroom with case-based learning for improving preservice teachers' classroom management learning outcomes," *Teach Teach Educ*, vol. 152, 104785, 2024. doi: https://doi.org/10.1016/j.tate.2024.104785

[67] A. Anderson, A. Ahmad, and S. Chang, "Case-based learning for cybersecurity leaders: A systematic review and research agenda," *Information & Management*, vol. 61, no. 7, 104015, 2024. doi: https://doi.org/10.1016/j.im.2024.104015

[68] F. Arab and M. Saeedi, "The effect of the case-based learning approach on the level of satisfactions and learning of nursing students in Iran: A randomized controlled trial," *Heliyon*, vol. 10, no. 15, e35149, 2024. doi: https://doi.org/10.1016/j.heliyon.2024.e35149

[69] I. C. Al-Hikmah, N. Netriwati, R. Widyastuti, and Y. Jamilah, "Enhancing problem-solving skills through the missouri mathematics project learning model with think talk write, reviewed from the perspective of adversity quotient," *Jurnal Cendekia: Mathematics Education Journal*, vol. 6, no. 2, pp. 1922–1934, 2022.

[70] S. Jablonski, "Show me the world–use and functions of gestures with mathcitymap," in *Proc. EDULEARN21*, 2021, pp. 1236–1245.

[71] A. Barbosa, I. Vale, S. Jablonski, and M. Ludwig, "Walking through algebraic thinking with theme-based (mobile) math trails," *Educ Sci (Basel)*, vol. 12, no. 5, p. 346, 2022.

[72] E. Widianti and A. Amidi, "Literature review: Students' mathematical literacy viewed from self-concept in the project-based learning model assisted by MathCityMap," in *Proc. of National Conference on Mathematics Education*, 2023, pp. 256–263.

[73] W. K. A. Ceriputri, A. P. Rini, and S. Saragih, "Adversity quotient: Is there a role for self-efficacy and transformational leadership?" *JIWA: Jurnal Psikologi Indonesia*, vol. 1, no. 2, 2023.

[74] N. Laili, "Relationship between adversity quotient and students' mathematics learning outcomes for distance learning in junior high schools," *Journal of Humanities and Social Sciences (JHASS)*, vol. 3, no. 1, pp. 33–39, 2021.

[75] B.-Q. Li and C.-R. Chen, "The reliability and validity of the adversity quotient scale in Chinese students," *Chinese Mental Health Journal*, vol. 22, no. 8, pp. 605–607, 2008.

[76] N. M. Deterding and M. C. Waters, "Flexible coding of in-depth interviews: A twenty-first-century approach," *Sociol Methods Res*, vol. 50, no. 2, pp. 708–739, 2021.

[77] B. F. Ismaya, A. N. Cahyono, and S. Mariani, "Mathematical reasoning skills with math trail project assisted by MathCityMap," presented at National Seminar of Mathematics Education Ahmad Dahlan, Yogyakarta, 2018.

[78] L. D. Afri, "The relationship between adversity quotient and middle school students' problem-solving ability in mathematics learning," *AXIOM: Mathematics and Mathematics Education Journal*, vol. 7, no. 2, 2018.

[79] M. Y. Ramadhan, S. Haji, and H. Sumardi, "The influence of mathematics phobia, adversity quotient, and locus of control on mathematical literacy in middle school students," *Jurnal Lebesgue: Scientific Journal of Mathematics Education, Mathematics, and Statistics*, vol. 4, no. 1, pp. 614–628, 2023.

[80] M. A. Prasetyo, L. Hayati, N. H. Salsabila, and M. Turmuzi, "The influence of Adversity Quotient (AQ) on students' statistical literacy skills," *Pendas: Scientific Journal of Elementary Education*, vol. 9, no. 2, pp. 772–786, 2024.

[81] M. Imron and A. Agoestanto, "The Influence of adversity quotient on students' mathematical literacy: A systematic literature review," *JUMLAHKU: Scientific Mathematics Journal of STKIP Muhammadiyah Kuningan*, vol. 9, no. 1, pp. 40–61, 2023.

[82] K. Mawardhiyah and J. T. Manoy, "Middle school students' mathematical literacy in solving Program for International Student Assessment (PISA) problems based on Adversity Quotient (AQ)," *MATHEdunesa*, vol. 7, no. 3, pp. 638–643, 2018.

[83] N. T. Nilasari and D. Anggreini, "Students' mathematical literacy skills in solving PISA problems viewed from adversity quotient," *Jurnal Elemen*, vol. 5, no. 2, pp. 206–219, 2019.

[84] H. W. Kim and M. K. Kim, "A case study of children's interaction types and learning motivation in small group project-based learning activities in a mathematics classroom.," *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 17, no. 12, 2021.

[85] N. Ramadhani and M. S. Hadi, "Systematic literature review: Mathematical literacy skills viewed from adversity quotient in mathematics learning," *Community Development Journal: Community Service Journal*, vol. 4, no. 2, pp. 1661–1668, 2023.

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