International Journal of Interdisciplinary Cultural Studies
ISSN: 2327-008X (Print), ISSN: 2327-2554 (Online)
Volume 21, Issue 1, 2026
https://cgscopus.com/index.php/journals

FEASIBILITY OF THE AQUACE MATHEMATICS LEARNING MODEL: A STUDY OF VALIDITY AND PRACTICALITY

Vivi Rosida
Mathematics Education Study program, Postgraduate
Universitas Negeri Makassar, Makassar, Indonesia.

Abdul Rahman*
Mathematics Education Study program, Postgraduate
Universitas Negeri Makassar, Makassar, Indonesia.
virirosida@student.unm.ac.id

Sabri
Mathematics Education Study program, Postgraduate
Universitas Negeri Makassar, Makassar, Indonesia.

Hamda
Mathematics Education Study program, Postgraduate
Universitas Negeri Makassar, Makassar, Indonesia.

Hamzah Upu
Mathematics Education Study program, Postgraduate
Universitas Negeri Makassar, Makassar, Indonesia.

Abstract: This study aimed to develop and examine the feasibility of the AQUACE (Adversity Quotient, Self-Confidence, and Self-Efficacy) mathematics learning model through validity and practicality testing. The research employed a research and development approach using the ADDIE framework, limited to the stages of analysis, design, development, implementation, and evaluation of validity and practicality. The study was conducted at a public senior high school in Makassar, Indonesia, involving 70 tenth-grade students and two mathematics teachers in a limited trial. Data were collected using expert validation sheets, classroom observation sheets, and teacher response questionnaires. The results of expert validation indicated that the AQUACE model achieved a high level of validity, with an overall mean score of 3.5, categorized as very valid. Classroom observations showed that the model was implemented fully, with an average implementation score of 1.9 and an inter-observer agreement of 99.1%, indicating strong practicality. In addition, teacher responses toward the model were very positive, with an average score of 88.6%, reflecting its attractiveness, usefulness, novelty, and ease of use. Overall, the findings demonstrate that the AQUACE learning model is valid and practical for mathematics instruction and has strong potential to support students' cognitive learning as well as their psychological resilience. Further studies are recommended to investigate its effectiveness on learning outcomes in broader contexts.

Keyword: AQUACE Model, Mathematics Learning, Validity, Practicality

INTODUCTION

Mathematics is a core subject within the educational curriculum and plays a vital role in fostering students' logical thinking, analytical reasoning, and problem-solving abilities (Komarudin & Suherman, 2024; Rocha & Babo, 2024; Supriadi et al., 2024). Mathematical competence also serves as a foundation for mastering various other disciplines, including science, technology, and economics. Nevertheless, the mathematics learning outcomes of Indonesian students remain relatively unsatisfactory. International large-scale assessments such as PISA and TIMSS consistently place Indonesia below the international average, particularly in terms of concept application, reasoning, and problem-solving skills (Factsheets, 2023; Ridwan & Sabri, 2024). These findings suggest that mathematics instruction in Indonesia has not yet fully equipped students with competencies aligned with the demands of the 21st century (Ramdhani & Suharti, 2024; Rehman et al., 2024).

Low achievement in mathematics is influenced not only by cognitive factors but also by non-cognitive aspects, especially students' self-confidence in learning mathematics (Byiringiro, 2024; Çiftçi, 2019; Guzeller & Akin, 2017; Iyamuremye, 2023). Many students perceive mathematics as a difficult and intimidating subject, which negatively affects their motivation and increases their tendency to give up when faced with challenging tasks. Research has consistently shown that low self-confidence significantly contributes to students' failure to achieve optimal learning outcomes. Students with limited self-confidence tend to be passive in class, reluctant to explore new strategies, and more prone to experiencing anxiety when dealing with mathematical problems (Zhou et al., 2025).

Beyond self-confidence, students' capacity to persist and recover from learning difficulties is another critical issue in mathematics education. A considerable number of students lack sufficient mental resilience, making them more likely to withdraw when encountering obstacles (Carroza-Pacheco & León-del-Barco, 2025; Dinapoli & Miller, 2022). In this context, Adversity Quotient (AQ) refers to an individual's ability to confront, manage, and overcome difficulties in a constructive manner. Students with strong AQ typically demonstrate perseverance, positive thinking, and the ability to view challenges as opportunities for growth. Therefore, mathematics instruction should incorporate efforts to strengthen students' resilience rather than focusing solely on content mastery (Anggraini & Mahmudi, 2021; Gradini & Noviani, 2025; Sutisna et al., 2022).

In addition to AQ and self-confidence, self-efficacy represents another psychological factor that strongly influences success in learning mathematics. Self-efficacy reflects students' beliefs in their capability to complete specific mathematical tasks. Learners with high self-efficacy tend to be more persistent, willing to take risks, and capable of regulating their learning strategies independently (Ruijia et al., 2022; Yang et al., 2024; Zakariya, 2012). Conversely, low self-efficacy is often associated with avoidance behaviors, lack of accuracy, and reluctance to engage with complex problems. Consequently, the integration of Adversity Quotient, self-confidence, and self-efficacy constitutes a crucial foundation for designing mathematics instruction that supports students' academic and psychological development in a balanced manner (Elisabeth et al., 2024).

Despite the recognized importance of these three factors, mathematics learning models that explicitly integrate Adversity Quotient, self-confidence, and self-efficacy remain limited. Existing instructional models tend to emphasize cognitive aspects and are rarely designed systematically to cultivate students' resilience and self-belief. Accordingly, this study develops the AQUACE Mathematics Learning Model (Adversity Quotient, Self-Confidence, and Self-Efficacy) and examines its feasibility in terms of validity and practicality. The AQUACE model is expected to serve as an innovative alternative in mathematics education that is not only academically effective but also capable of fostering resilient, confident students who believe in their ability to face both learning challenges and real-life situations.

METHODOLOGY

1. Research Design

This study employs a Research and Development (R&D) approach aimed at producing the AQUACE Mathematics Learning Model, which integrates Adversity Quotient, self-confidence, and self-efficacy, and at examining its levels of validity and practicality. A development-oriented approach was selected because the study focuses on creating an instructional product grounded in theoretical analysis and subjected to limited testing within an authentic learning context (Adeoye et al., 2024; Cela-Ranilla & Valladolid, 2025). The development process follows the ADDIE framework, which consists of five sequential stages: Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model was chosen due to its systematic structure and its capacity to support continuous evaluation at each stage of instructional development. In this study, the scope of implementation is limited to assessing the model's validity and practicality; therefore, large-scale testing of the model's effectiveness has not yet been undertaken.

2. Research Participants and Setting

The research was conducted at SMAN 1 Makassar in the even semester of the 2024/2025 academic year with several academic considerations. First, this school is one of the high schools with good academic quality and implements mathematics learning that aligns with the demands of the Independent Curriculum, thus supporting the implementation of innovative learning models. Second, the school and mathematics teachers demonstrated openness and readiness to engage as model users during the limited trial phase. Third, the heterogeneous characteristics of students in terms of academic ability and learning readiness provide a representative context for assessing the effectiveness of the Adversity Quotient-based learning model that involves self-confidence and self-efficacy. Therefore, SMAN 1 Makassar is considered a relevant and strategic location to achieve the research objectives. The sampling technique in this study was random sampling, thus selecting two grades of 10 in Trial I and Trial II, as well as two mathematics teachers who acted as model users in the limited trial.

3. Development Procedure Model

The development of the AQUACE learning model was carried out through the following stages:

a. Analysis Stage

This stage involved a needs analysis conducted through a review of relevant literature, preliminary observations of mathematics classroom practices, and the identification of students' learning difficulties related to resilience in facing challenges, self- confidence, and self-belief in mathematics learning.

b. Design Stage.

At this stage, the initial design of the AQUACE model was formulated, encompassing the instructional syntax, social system, principles of reaction, support system, as well as the intended instructional and nurturant effects. In addition, supporting instructional materials were developed, including learning modules, student worksheets (LKPD), and research instruments.

c. Development Stage

The initial product was subsequently validated by two experts in mathematics education. Feedback and suggestions provided by the validators were used as the basis for revising the model until a version deemed suitable for field testing was obtained.

d. Implementation Stage

The revised AQUACE learning model was implemented through a limited trial in mathematics instruction on the topic of quadratic equations over four instructional sessions.

e. Evaluation Stage

Evaluation was conducted to assess the validity and practicality of the AQUACE learning model based on data obtained from expert validation and the limited trial implementation.

4. Data Analysis Validity and Practicality

The validity instrument is used to obtain information regarding the validity of the model, tools, and instruments to be used based on the assessment of the validator team. The validators in question are mathematics experts from among the teachers. The data obtained is used to assess the validity of the previously developed model, tools, and instruments. The validation form is a validation sheet with options according to the validator team's assessment rubric. This validation sheet was developed by the P3MP Team of Makassar State University. The level of practicality of the learning model in this study was measured using a model implementation questionnaire and teacher responses to the developed model.

a. Validity Data Analysis

Validation data includes validation of models, learning devices and research instruments that are at least in the valid category. The activities carried out in the validity data analysis process include: (1) syntax and Development Guidebook; (2) learning devices in the form of learning materials; and (3) research instruments including learning outcome tests, Adversity intelligence questionnaires, teacher and student response questionnaires, student activity observation sheets, and observation sheets on the implementation of the use of learning models. The categories for assessing the feasibility of products, learning devices and research instruments according to Arsyad, 2013; Utami, 2024 are as follows:

Table 1. Expert Validation Criteria

Intervals	Category	Information
$3.5 \leq \boldsymbol{M} \leq 4$	Very Valid	No Revision Required
$2.5 \leq \boldsymbol{M} < 3.5$	Valid	No Revision Required
$1.5 \leq \boldsymbol{M} < 2.5$	Fairly Valid	Minor Revisions
$\boldsymbol{M} < 1.5$	Invalid	Change

International Journal of Interdisciplinary Cultural Studies
ISSN: 2327-008X (Print), ISSN: 2327-2554 (Online)
Volume 21, Issue 1, 2026
https://cgscopus.com/index.php/journals

Practical analysis is used, using the following formula:

$$V_p = \frac{TS_p}{TS_h} x100\% \quad (1)$$

Information:
V_p : Percentage score from questionnaire sheet TS_p : Total score obtained from users
TS_h : The highest possible total score that can be obtained

The criteria used to decide that a product, learning device and research instrument has an adequate level of validity is that the score for all components is at least in the adequate category or at a moderate level of validity.

b. Practical Data Analysis

Practicality data includes the feasibility of model use and teacher responses. Data on feasibility of model use were obtained from observation sheets completed by observers during observations of teachers using the model in learning. The feasibility of model use in learning was categorized using the categories in the following table:

Table 2. Conversion of Values for the Level of Implementation of Model Use

Interval	Kategori
$1{,}5 \leq \boldsymbol{T} \leq 2$	Completely Implemented
$0{,}5 \leq \boldsymbol{T} < 1{,}5$	Partially Implemented
$0{,}0 \leq \boldsymbol{T} < 0{,}5$	Not Implemented

Source: Arsyad (2016)

The criteria used to decide that the use of the model has an adequate degree of implementation based on the observation results is the percentage value for each indicator of the implementation of the use of the model is at least in the partially implemented category, if not, then a revision is carried out before continuing the observation of the implementation of the learning model. Next, the reliability of the observation sheet for the implementation of the model is calculated using the modified results of the Grinner percentage of agreements formula.

$$Percerage\ of\ Agreements\ (R) = \frac{Agreements}{Disagreements+Agreements} x100\% \quad (2)$$

Description:
Agreements : The number of frequencies of agreement between two observers Disagreements: The number of frequencies of disagreement between two observers
R : Instrument reliability
The model feasibility sheet criteria are considered reliable if the reliability value (R) is ≥ 0.75.

In this context, teacher response data will be obtained from the results of a questionnaire administered to teachers after the lesson ends. Teacher response data is analyzed by looking at the average score of teacher responses. The following is a categorization of teacher responses using the categories according to Arsyad (2016):

International Journal of Interdisciplinary Cultural Studies
ISSN: 2327-008X (Print), ISSN: 2327-2554 (Online)
Volume 21, Issue 1, 2026
https://cgscopus.com/index.php/journals

Table 3. Conversion of Teacher Response Level Values

Intervals	Categories
PRG < 50%	Not Positive
50% < PRG ≤ 60%	Less Positive
60% < PRG ≤ 70%	Quite Positive
70% < PRG ≤ 85%	Positive
85% < PRG ≤ 100%	Very Positive

Description: PRG: Percentage of Teacher Responses

A teacher's response to a learning model is considered positive if they provide a positive response to at least 70% of the aspects asked. A positive teacher response to the model's use is considered achieved if the criteria for a positive teacher response are met.

RESULT AND DISCUSSION

Result

1. Design of the AQUACE Learning Model

The results of this development and research include the validation results by expert validators and the practicality of the AQUACE learning model reviewed from the practicality of the learning model and teacher responses. The following is an overview of the AQUACE learning model. The AQUACE learning model consists of several main menus, namely: Cover page, introduction, learning materials, learning activities, learning activity objectives, display design on the Human Machine Interface (HMI), student worksheets (LKS), evaluation questions, answer keys, glossary, and bibliography. The following is a display of the main menu of MPHMI.

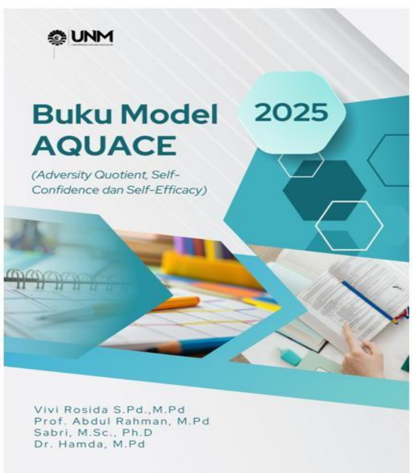

Figure 2. AQUACE Model Cover Design

a. Input

The analysis phase examines student characteristics, initial mathematics abilities, adversity quotient, self-confidence, and self-efficacy. Teacher readiness to facilitate students' affective and psychological aspects, including the ability to provide reinforcement, emotional support, and motivational scaffolding. Furthermore, the AQUOCE learning model is designed to support student resilience and self-confidence in learning mathematics.

International Journal of Interdisciplinary Cultural Studies
ISSN: 2327-008X (Print), ISSN: 2327-2554 (Online)
Volume 21, Issue 1, 2026
https://cgscopus.com/index.php/journals

b. Model Syntax Process

The implementation of the AQUOCE learning model is realized through structured learning syntax. The first phase is self-reflection, helping students recognize their initial conditions as a first step in facing future challenges. Next, in the second phase, students develop a strategic plan for solving problems to strengthen self-confidence. The third phase aims to increase students' confidence in their abilities (self-efficacy). In the fourth phase, students implement and manage obstacles in solving the problem, thus developing resilience and responsibility in the face of difficulties. After that, they enter the fifth phase, presenting the answers and internalizing the strengths and obstacles they face. The final phase involves conducting evaluation and feedback, to strengthen the meaning of learning and student resilience on an ongoing basis.

c. Output

The main achievement was an improvement in students' mathematics learning outcomes before and after implementing the AQUOCE learning model. Furthermore, the implementation of this model also impacted students' affective aspects, as indicated by an increase in their adversity quotient, self-confidence, and self-efficacy. This development was reflected in students' increased resilience in the face of difficulties, their courage to try various strategies, and their confidence in solving mathematics problems.

d. Evaluation of the Learning Process

Evaluation of the learning process was conducted to assess the extent to which the objectives of the learning model were achieved comprehensively. The evaluation process included a learning outcome test as an indicator of students' cognitive achievement, an internalization assessment to assess students' reflection and affective development, and implementation observations to ensure that the AQUOCE model syntax was implemented consistently according to the design.

e. Lingkungan Pendukung

Lingkungan pendukung berperan sebagai unsur penguat dalam keberhasilan penerapan model pembelajaran AQUOCE. Peran guru sebagai fasilitator pembelajaran tercermin dari kemampuan dalam mengarahkan dan membimbing siswa, serta menyediakan dukungan yang dibutuhkan agar siswa mampu terlibat aktif dan belajar secara mandiri. Keselarasan dengan kebijakan kurikulum diwujudkan melalui penerapan profil lulusan yang mengintegrasikan penguatan karakter dan kemandirian. Di samping itu, ketersediaan perangkat pembelajaran AQUOCE yang dirancang sesuai dengan karakteristik dan kebutuhan model menjadi acuan bagi guru dalam melaksanakan sintaks pembelajaran secara terarah, konsisten, dan efektif.

2. Results of the Validation Test and Practicality of the Implementation of the AQUACE Model

3.

The validity of the product includes the model, tools and learning instruments that have been validated by two experts and then received the average validator assessment as follows.

International Journal of Interdisciplinary Cultural Studies
ISSN: 2327-008X (Print), ISSN: 2327-2554 (Online)
Volume 21, Issue 1, 2026
https://cgscopus.com/index.php/journals

Table 4. Validation Results of the Validator Team's Assessment

Product	Indicator	Average Rating	Categories
Learning model			
	Syntax	3,6	Very Valid
	Social Systems	3,3	Valid
	Reaction Principles	3,4	Valid
	Support System	3,2	Valid
	Instructional Impact and Accompanying Impact	3,5	Very Valid
Learning Tools			
lesson plan	Contents	3,5	Very Valid
	Construct	3,2	Valid
	Language	3,5	Very Valid
Teaching materials	Contents	3,4	Valid
	Construct	3,3	Valid
	Language	3,5	Very Valid
Student Worksheet	Contents	3,7	Very Valid
	Construct	3,5	Very Valid
	Language	3,5	Very Valid
Learning Instrument			
Learning implementation instrument validation sheet	Contents	3,4	Valid
	Construct	3,5	Very Valid
	Language	3,6	Very Valid
Learning management	Contents	3,5	Very Valid
	Construct	3,6	Very Valid
	Language	3,5	Very Valid
Student Activities	Contents	3,5	Very Valid
	Construct	3,5	Very Valid
	Language	3,6	Very Valid
Teacher Response	Contents	3,7	Very Valid
	Construct	3,4	Valid
	Language	3,5	Very Valid
Student Response	Contents	3,5	Very Valid
	Construct	3,7	Very Valid
	Language	3,5	Very Valid
Learning Results Test	Contents	3,4	Very Valid
	Construct	3,5	Very Valid
	Language	3,5	Very Valid
AQUACE Questionnaire	Contents	3,6	Very Valid
	Construct	3,4	Valid
	Language	3,6	Very Valid

Source: 2025 Data Analysis Results

Based on Table 1, the assessment of each aspect of the AQUACE learning model, learning tools, and research instruments developed. Furthermore, a summary of the validation analysis results by validator 1 and validator 2 for each instrument is described in Table 2 below:

Table 5. Summary of Validation Results of the Validator Team's Assessment

Produk	Rata-rata Penilaian	Kategori
Learning model	3,4	Valid
lesson plan	3,4	Valid
Module Book	3,4	Valid
student worksheets	3,6	Very Valid
Learning implementation instrument validation sheet	3,5	Very Valid
Learning management	3,4	Valid
Student Activities	3,5	Very Valid
Teacher Response	3,5	Very Valid
Student Response	3,5	Very Valid
Learning Results Test	3,5	Very Valid
AQUACE Questionnaire	3,5	Very Valid
Average Total Rating	**3,5**	Very Valid

Source: 2025 Data Analysis Results

Based on the table, the average validation result was 3.5, which is in the very valid category, meaning the developed product is ready for testing. The instruments used to measure the practicality of the AQUACE learning model were the observation sheet for the implementation of the AQUACE learning model and the teacher response questionnaire. The results of the analysis of both data sets can be seen below:

Table 6. Results of the Analysis of the Implementation of the Syntax of the AQUACE Learning Model

Sub Indicator	Observed Aspects		Observation result							
			P1		P2		P3		P4	
	Teacher Activities	Student Activities	O1	O2	O1	O2	O1	O2	O1	O2
Phase 1: Awareness Building (Building Self-Awareness and Challenge)	Start the class by greeting and checking attendance.	Answering greetings and taking attendance	1	1	2	2	2	2	2	2
	Perform opening greetings	Students respond to the teacher's opening greeting.	2	2	2	2	2	2	2	2
	The teacher directs one of the students to lead the prayer.	Students pray before starting learning activities, led by one of the students to lead the prayer.	2	2	2	2	2	2	2	2
	The teacher checks the students' attendance.	Students confirm attendance.	1	1	2	2	2	2	2	2

	The teacher conveys the topic, objectives and benefits of learning.	Students Listen.	2	2	1	2	2	2	2	2
	Explains the importance of having fighting spirit and self-confidence in learning.	Students are motivated and enthusiastic about learning.	2	2	2	2	2	2	2	2
	Offer a spark in the form of an inspirational quote or short story relevant to challenges and the spirit of never giving up. Or watch an inspirational video together about Adversity Quotient, Self-Confidence, and Self-Efficacy.	Students listen to stories or video shows	2	2	2	2	2	2	2	2
	The teacher explains the material on Quadratic Equations	Students pay close attention.	2	2	2	2	2	2	2	2
Phase 2: Challenge Engagement	Divide the group into heterogeneous categories (Quitter, Camper, Climber).	Students are grouped according to the categories given by the teacher.	2	2	2	2	2	2	2	2
	Each team is given a red and green flag. Red means surrender, and green means ready to continue the challenge.	Students take 2 flags	2	2	2	2	2	2	2	2
	Explains group work rules and problem-solving techniques. (Game rules and structure are attached)	Analyze information, build mathematical models or problem-solving strategies.	2	2	2	2	2	2	2	2
	Directing students to work on the challenges in the LKPD	Students and their teams begin working on the challenges in the LKPD.	2	2	2	2	2	2	2	2

International Journal of Interdisciplinary Cultural Studies
ISSN: 2327-008X (Print), ISSN: 2327-2554 (Online)
Volume 21, Issue 1, 2026
https://cgscopus.com/index.php/journals

	Direct students to immediately continue to the next level of questions	Students can work on questions at the next level if they have completed the questions at the previous level.	2	2	2	2	2	2	2	2
	Encourage students to work together and try to solve problems without fear of being wrong.	Students work together in teams full of enthusiasm	2	2	2	2	2	2	2	2
Phase 3: Supportive Reflection (Reflection and Constructive Feedback)	Provide reflective questions about thought processes, emotions felt, and strategies used.	Fill in the reflection section on the LKS: write down the difficulties faced, how to overcome them, and how you feel after trying.	2	2	2	2	2	2	2	2
	Encourage students to realize that failure is part of the learning process.	Acknowledge small successes and learn from mistakes.	2	2	2	2	2	2	2	2
	Provide positive reinforcement for students' efforts and perseverance.	Listening and supporting friends.	2	2	2	2	2	2	2	2
Phase 4: Reinforcement and Strategy Building	Invite students to discuss alternative strategies and more effective ways to solve challenges.	Identifying strategies that have been used successfully.	1	1	2	2	2	2	2	2
	Provide examples of realistic success strategies that students can emulate.	Develop or choose new strategies to face similar challenges in the future.	2	2	2	2	2	2	2	2
	Provide a space for students to share their experiences and how they recovered from difficulties.	Share experiences and solutions with classmates.	1	1	2	2	2	2	2	2
Phase 5: Internalization and Goal	Provide specific time for students to do final reflection.	Write down the lessons learned today regarding resilience, self-	2	2	2	2	2	2	2	2

International Journal of Interdisciplinary Cultural Studies
ISSN: 2327-008X (Print), ISSN: 2327-2554 (Online)
Volume 21, Issue 1, 2026
https://cgscopus.com/index.php/journals

Setting		confidence, and self-belief.								
	Guide students to conclude important lessons from the day's learning activities.	Develop learning objectives for the next meeting.	2	2	2	2	2	2	2	2
	Encourage students to set personal learning targets and strategies to achieve them.	Expressing personal commitment to face challenges with a more resilient attitude.	2	2	2	2	2	2	2	2
Phase 6: Evaluation & Climbing Feedback	Provide reinforcement for the material that has been studied	Summarize the material that has been studied	2	2	2	2	2	2	2	2
	Asking questions/quizzes/individual tests to determine students' critical thinking skills	Complete the test and submit the answers for assessment	2	2	2	2	2	2	2	2
	Provide feedback and assessment of game results. Students are guided to identify their position on the climbing map (Quitter/Camper/Climber) and develop a plan for improvement for the next session.	Revise each student's genetic decomposition and collect it	2	2	2	2	2	2	2	2
	Informing the next assignment	Note down assignments	2	2	2	2	2	2	2	2
Average Observation of Implementation of Syntax Aspects			1,8	1,8	2,0	2,0	2,0	2,0	2,0	2,0
Agreement			27		26		27		27	
Disagreement			0		1		0		0	
Average Per Meeting			1,8		2,0		2,0		2,0	

Source: 2025 Data Analysis Results

Based on Table 3, the average observation score for two observers was 1.9, indicating that all aspects of the AQUACE learning model were fully implemented. This is supported by the number of agreements between the two observers, which was 27 and the number of disagreements was 0. This means that both observers agreed that the syntax component of the AQUACE learning model was implemented, with an agreement percentage of 99.1%.

International Journal of Interdisciplinary Cultural Studies
ISSN: 2327-008X (Print), ISSN: 2327-2554 (Online)
Volume 21, Issue 1, 2026
https://cgscopus.com/index.php/journals

Teacher response data to the AQUACE Learning Model was obtained from a questionnaire administered to teachers after using the AQUACE Learning Model. This questionnaire was administered only at the final meeting of this limited trial. The teacher response data to the AQUACE Learning Model can be seen in Table 4:

Table 7. Summary of Teacher Response Data to the AQUACE Learning Model

Nu.	Aspect	Achievement (%)	Categories
1	Attractiveness	92	Very Positive
2	Novelty	90	Very Positive
3	Usefulness	80	Very Positive
4	Convenience	91,4	Very Positive
Average		88,6	Very Positive

Source: 2025 Data Analysis Results

Based on the summary table of teacher responses to the AQUACE learning model, it can be seen that all assessed aspects received a very positive rating. On average, the score of 88.6% placed teacher responses in the very positive category. This means that teachers see this model as having the potential to support the learning process and provide new and beneficial experiences. Therefore, it can be concluded that the AQUACE model was well-received by teachers and has the potential for continued development and wider use in learning activities.

Based on the analysis of the implementation of the AQUACE learning model and teacher responses, it can be concluded that the AQUACE learning model meets the criteria of practicality and is suitable for dissemination. The model's implementation rating, which falls within the fully implemented category with an average of 1.9, indicates that all model syntax and components can be optimally implemented in learning. Furthermore, very positive teacher responses, ranging from 80% to 92%, for aspects of interestingness, novelty, usefulness, and ease of use indicate that the AQUACE model is considered interesting, useful, and easy to implement in the classroom. Thus, the AQUACE learning model has been proven to be practical and ready to be tested at the dissemination stage to see the effectiveness of its application on a wider scale.

Discussion

1. Design of the AQUACE Learning Model

The AQUACE learning model was developed to address persistent limitations in mathematics instruction, particularly the dominance of cognitively oriented approaches that pay insufficient attention to students' psychological readiness when confronting learning difficulties. By integrating Adversity Quotient, self-confidence, and self-efficacy within a unified instructional framework, AQUACE offers a more holistic learning model that aligns with contemporary perspectives on student resilience and motivation in mathematics education.

From a theoretical standpoint, the design of the AQUACE model is grounded in social cognitive theory, which emphasizes the reciprocal interaction between personal beliefs, learning behaviors, and the learning environment. The initial phases of the model *Awareness Building* and *Challenge Engagement* are deliberately structured to cultivate students' awareness of learning challenges while simultaneously encouraging active engagement in mathematical problem-solving. Recent international studies indicate that structured exposure to manageable challenges can strengthen students' self-efficacy and perseverance, particularly in mathematics learning contexts that are often characterized by anxiety and avoidance behaviors (Panadero et al., 2022; Schunk & DiBenedetto, 2019).

A distinctive feature of the AQUACE model lies in its classification of students into the categories of *Quitter*, *Camper*, and *Climber*. This categorization functions as a form of psychological scaffolding rather than as a fixed labeling mechanism. Such an approach is consistent with resilience-based learning research, which highlights the importance of adaptive responses to failure and gradual improvement rather than immediate performance outcomes (OECD, 2022). Unlike conventional cooperative or problem-based learning models, AQUACE explicitly positions the management of learning difficulties as a core instructional objective, rather than treating it as a secondary outcome of problem-solving activities.

Furthermore, the inclusion of reflection and goal-setting phases within the instructional syntax reinforces the internalization of students' learning experiences. Empirical evidence from international literature suggests that structured reflection enhances students' self-regulation and supports sustained learning persistence over time (De Backer et al., 2021). In this regard, AQUACE extends existing instructional models by systematically integrating affective reflection alongside cognitive reflection, thereby contributing to the development of resilient learning behaviors.

Nevertheless, several studies caution that the successful implementation of psychologically oriented learning models is highly dependent on teachers' facilitation skills. Educators who are less experienced in managing students' emotional responses may encounter challenges in sustaining reflective dialogue and providing supportive feedback (Klusmann et al., 2022). This indicates that, although the conceptual design of the AQUACE model is theoretically robust, its practical effectiveness may vary depending on teachers' readiness and instructional experience.

2. Results of Validity and Practicality Testing of the AQUACE Model

The results of expert validation indicate that the AQUACE learning model achieved a high level of validity, with an overall mean score of 3.5, which falls within the *very valid* category. High validation scores across the core components including instructional syntax, social system, principles of reaction, and support system demonstrate strong internal coherence and sound pedagogical feasibility. These findings are consistent with prior design-based research, which emphasizes expert validation as a critical stage for ensuring both theoretical alignment and practical relevance in instructional innovations (Plomp, 2013; van den Akker et al., 2020).

In terms of practicality, classroom observations revealed that the AQUACE model was implemented as intended, with an average implementation score of 1.9 and an inter-observer agreement of 99.1%. This high level of consistency suggests that the model's instructional stages are clearly defined and operationally feasible for classroom application. International studies similarly report that instructional models with well-structured and explicit phases tend to be implemented more consistently across learning sessions (Karsten & van Zyl, 2022).

Teacher responses further reinforce the practicality of the model. The very positive mean teacher response score (88.6%) reflects teachers' perceptions of AQUACE as an engaging, innovative, useful, and easy-to-implement instructional model. Broad teacher acceptance is widely recognized as a key determinant of the sustainability of educational innovations, particularly at the secondary education level (Liu et al., 2024; Porlán-Ariza et al., 2026). Such positive perceptions suggest that the AQUACE model holds strong potential for adoption beyond the research setting or limited trial context.

Nevertheless, evidence from international longitudinal studies indicates that initial positive responses do not always translate into sustained learning impacts over the long term (Kim, 2025). Therefore, while the present findings demonstrate that the AQUACE model is both valid and practical for classroom use, further research is required to examine its effectiveness in enhancing students' learning outcomes and resilience across broader contexts and longer instructional periods.

Overall, the findings of this study indicate that the AQUACE learning model meets the criteria of a feasible and practically applicable instructional innovation. Its emphasis on integrating cognitive learning processes with psychological resilience represents a meaningful contribution to mathematics education, particularly in learning contexts where students commonly experience difficulties in developing self-confidence and learning persistence.

CONCLUSSION

Based on the research results, the results of the validity of the AQUACE learning model were obtained from the results of the validator or expert validation and the practicality of the AQUACE learning model from the results of the practicality and teacher responses to the AQUACE learning model, so that the following conclusions can be drawn. The validity of the AQUACE learning model was obtained from the results of validation by two (2) expert validators, with an average total assessment of 3.5. So from these results it can be concluded that the validity of the AQUACE learning model is categorized as very valid. The practicality of the AQUACE learning model was obtained based on the implementation of the learning model with an average of 1.9 which means that the implementation of the aspects of the AQUACE learning model was fully implemented. While a score of 88.6% places the teacher's response in the very positive category. Based on these results it can be concluded that the AQUACE learning model is very practical or very good for use by students. From the conclusion of the validity and practicality of the AQUACE learning model, research on the development of the AQUACE learning model can be used for the learning process.

REFERENCES

Adeoye, M. A., Adrian, K., Indra, S., Satya, M. S., & Septiarini, N. I. (2024). Revolutionizing Education: Unleashing the Power of the ADDIE Model for Effective Teaching and Learning. *Jurnal Pendidikan Indonesia*, *13*(1), 202–209. https://doi.org/https://doi.org/10.23887/jpiundiksha.v13i1.68624

Anggraini, T. W., & Mahmudi, A. (2021). Exploring the s tudents ' adversity quotient in online mathematics learning during the Covid-19 pandemic. *Journal of Research and Advances in Mathematics Education*, *6*(3), 221–238. https://doi.org/10.23917/jramathedu.v6i3.13617

Arsyad, A. (2016). *Media pembelajaran*. PT Raja Grafindo Persada.

Byiringiro, E. (2024). East African Journal of Education Studies The Effect of Students Self- Confidence on Mathematics Achievement in High School in Korea. *East African Journal of Education*, *7*(1), 231–239. https://doi.org/10.37284/eajes.7.1.1765

Carroza-pacheco, A. M., & León-del-barco, B. (2025). Academic Performance and Resilience in Secondary Education Students. *Journal of Intelligence*, *13*(56), 1–13. https://doi.org/https://doi.org/10.3390/jintelligence13050056

Cela-ranilla, J., & Valladolid, U. De. (2025). Design-based research in higher education : A systematic literature review between 2019 and 2023. *Australasian Journal of Educational Technology*, *41*(4), 67–83.

Çiftçi, Ş. K. (2019). The Effect of Self-Confidence on Mathematics Achievement : The Meta- Analysis of Trends in International Mathematics and Science Study. *International Journal of Instruction*, *12*(2), 683–694.

De Backer, L., Van Keer, H., & Valcke, M. (2021). Collaborative learning groups' adoption of shared metacognitive regulation: examining the impact of structuring versus reflection- provoking support and its relation with group performance. *European Journal of Psychology of Education*, *36*(4), 1075–1094.

Dinapoli, J., & Miller, E. K. (2022). Recognizing , supporting , and improving student perseverance in mathematical problem-solving : The role of conceptual thinking scaffolds. *Journal of Mathematical Behavior*, *66*(4), 100965. https://doi.org/10.1016/j.jmathb.2022.100965

Elisabeth, K., Street, S., Erik, L., & Stanislaw, M. (2024). Students' mathematics self - efficacy: a scoping review. *ZDM – Mathematics Education*, *56*, 265–280. https://doi.org/10.1007/s11858-024-01548-0

Factsheets. (2023). *PISA 2022 Results (Volume I and II) - Country Notes: Indonesia*.

Gradini, E., & Noviani, J. (2025). Students Profile of Adversity Quotient in Mathematics Learning: Control , Origin and Ownership , Reach , and Endurance. *American Journal of STEM Education*, *3*, 84–104. https://doi.org/https://doi.org/10.32674/2y5p9359

Guzeller, C. O., & Akin, A. (2017). Role of Mathematical Self-Efficacy and Self-Concept in Mathematics Achievement : A Structural-Motivational Model Matematik Başarısında Matematik Öz - Yeterliği ve Matematik Benlik Saygısının Rolü : Yapısal -Motivasyonel Bir Model. *Mediterranean Journal of Humanities*, *7*(2), 293–306. https://doi.org/10.13114/MJH.2017.364

Iyamuremye, E. (2023). Relationships of mathematics achievement with self-determined motivation and mathematics anxiety among senior two students in Northern Rwanda. *Heliyon*, *9*(4), 1–11. https://doi.org/10.1016/j.heliyon.2023.e15411

Karsten, I., & Zyl, A. Van. (2022). Design-Based Research (DBR) as an Effective Tool to Create Context-Sensitive and Data-Informed Student Success Initiatives. *Journal of Student Affairs in Africa*, *10*(1), 15–31. https://doi.org/10.24085/jsaa.v10i1.3706

Kim, A. (2025). Impact of Systematic Support in Teacher Education and Professional Development on Training - Teaching Alignment and Instructional Quality. *Journal for STEM Education Research*, 1–26. https://doi.org/10.1007/s41979-025-00154-3

Klusmann, B., Trippenzee, M., Fokkens-bruinsma, M., Sanderman, R., & Schroevers, M. J. (2022). Providing emergency remote teaching: What are teachers' needs and what could have helped them to deal with the impact of the COVID-19 pandemic ? *Teaching and Teacher Education*, *118*, 103815. https://doi.org/10.1016/j.tate.2022.103815

Komarudin, K., & Suherman, S. (2024). The RMS teaching model with brainstorming technique and student digital literacy as predictors of mathematical literacy. *Heliyon*, *10*(06), 1–15. https://doi.org/10.1016/j.heliyon.2024.e33877

Liu, S., Yin, H., Wang, Y., & Lu, J. (2024). Teacher innovation: Conceptualizations, methodologies, and theoretical framework. *Teaching and Teacher Education*, *145*, 104611.

OECD. (2022). *Building academic resilience in students*. OECD Publishing.

Panadero, E., Jonsson, A., & Botella, J. (2022). Effects of self-regulated learning scaffolds. *Educational Psychology Review*, *34*(1), 101–112.

Porl´an-Ariza, R., Villarejo-Ramos, ´Angel F., Ledesma-Chaves, P., & Cordero, E. G.-. (2026). Factors influencing the adoption of teaching innovations by university teachers: A comparative analysis using the FS / QCA-NCA methodology. *Thinking Skills and Creativity*, *60*, 1–19. https://doi.org/10.1016/j.tsc.2025.102059

Ramdhani, L., & Suharti. (2024). Tinjauan Kritis terhadap Kurikulum Matematika Indonesia: Antara Kompetensi dan Kebutuhan Abda 21. *DIKMAT: Jurnal Pendidikan Matematika*, *05*(01), 24–29. https://jurnal.habi.ac.id/index.php/Dikmat

Rehman, N., Huang, X., Mahmood, A., AlGerafi, M. A. M., & Javed, S. (2024). Project-based learning as a catalyst for 21st-Century skills and student engagement in the math classroom. *Heliyon*, *10*(23), e39988. https://doi.org/10.1016/j.heliyon.2024.e39988

Ridwan, V. T. F., & Sabri, S. (2024). The Description of Mathematical Reasoning Abilities on the Topic of Fraction Operation on Grade VII of SMP Negeri 35 Makassar. *UNM International Proceeding*, 435–441.

Rocha, H., & Babo, A. (2024). Problem-solving and mathematical competence : A look to the relation during the study of Linear Programming. *Thinking Skills and Creativity*, *51*(4), 101461. https://doi.org/10.1016/j.tsc.2023.101461

Ruijia, Z., Talib, O., & Aimi, N. (2022). The Effect of Math Self-Concept and Self-Efficacy on the Math Achievement of Sixth-Grade Primary School Students : The Mediating Role of Math Anxiety. *International Journal of Academic Research in Progressive Education and Development*, *11*(3), 729–739. https://doi.org/10.6007/IJARPED/v11-i3/14721

Schunk, D. H., & Dibenedetto, M. K. (2019). Motivation and Social Cognitive Theory. *Contemporary Educational Psychology*, *60*, 101–112. https://doi.org/10.1016/j.cedpsych.2019.101832

Supriadi, N., Z, W. J., & Suherman, S. (2024). The role of learning anxiety and mathematical reasoning as predictor of promoting learning motivation : The mediating role of mathematical problem solving. *Thinking Skills and Creativity*, *52*(2), 101497. https://doi.org/10.1016/j.tsc.2024.101497

Sutisna, E., Novaliyosi, Hendrayana, A., & Mutaqin, A. (2022). Systematic Literature Review : Adversity Quotient dan Kemampuan Pemecahan Masalah pada Pembelajaran Matematika pembelajaran , misalnya kemampuan berpikir kritis matematis memiliki korelasi atau. *UNION: Jurnal Ilmiah Pendidikan Matematika*, *10*(2), 253–267. https://doi.org/http://dx.doi.org/10.30738/union.v10i2.12528

Yang, Y., Maeda, Y., & Gentry, M. (2024). The relationship between mathematics self - efficacy and mathematics achievement: multilevel analysis with NAEP 2019. *Large-Scale Assessments in Education*, *12*(6), 1–29. https://doi.org/10.1186/s40536-024-00204-z

Zakariya, Y. F. (2012). Improving students ' mathematics self-e cacy : A systematic review of intervention studies. *Frontiers Psychology*, *13*, 1–13. https://doi.org/10.3389/fpsyg.2022.986622

Zhou, Y., Jing, B., Ma, H., & Liu, H. (2025). Perceived Teacher Support Profiles and Students ' Mathematics Engagement , Anxiety and Attitude : A Latent Profile Analysis. *Behavioral Sciences*, *15*, 1–18. https://doi.org/https://doi.org/10.3390/bs15111578