Building Mathematical Identity Through Gamified Learning: A Development Study Using Wordwall Platform in Junior High School

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Abstrack

This research aims to build students' mathematical identity by developing gamification-based learning media on the Wordwall platform. Employing a Research and Development (R&D) approach with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation), the study involved 30 seventh-grade students of SMP Negeri 4 Pare, Kediri Regency. Data were collected through observation, interviews, questionnaires, and pre–post mathematical identity tests. Expert validation results showed the media was highly valid (average score = 4.36). At the same time, the N-Gain value of 0.57 (moderate) indicated a significant improvement in students' mathematical identity, particularly in engagement (0.66), value and meaning (0.54), and self-confidence (0.52). These findings demonstrate that gamification does not merely enhance cognitive learning outcomes but also constructs mathematical identity through positive social–emotional experiences, such as collaboration, reflection, and recognition. Theoretically, this research supports Boaler's (2021) concept of mathematical freedom and Martin's (2019) theory of social positioning, and, practically, offers an inclusive digital learning model that encourages confidence, engagement, and meaningful participation in mathematics.
Keywords: identity mathematical, gamification, wordwall, media learning digital, ADDIE

Abstrak

Penelitian ini bertujuan untuk membangun identitas matematika siswa dengan mengembangkan media pembelajaran berbasis gamifikasi pada platform Wordwall. Menggunakan pendekatan Penelitian dan Pengembangan (R&D) dengan model ADDIE (Analisis, Desain, Pengembangan, Implementasi, Evaluasi), penelitian ini melibatkan 30 siswa kelas tujuh SMP Negeri 4 Pare, Kabupaten Kediri. Data dikumpulkan melalui observasi, wawancara, kuesioner, dan tes identitas matematika pra-pasca. Hasil validasi ahli menunjukkan media sangat valid (skor rata-rata = 4,36). Pada saat yang sama, nilai N-Gain sebesar 0,57 (sedang) menunjukkan peningkatan yang signifikan dalam identitas matematika siswa, khususnya dalam keterlibatan (0,66), nilai dan makna (0,54), dan kepercayaan diri (0,52). Temuan ini menunjukkan bahwa gamifikasi tidak hanya meningkatkan hasil belajar kognitif tetapi juga membangun identitas matematika melalui pengalaman sosial-emosional yang positif, seperti kolaborasi, refleksi, dan pengakuan. Secara teoritis, penelitian ini mendukung konsep kebebasan matematika Boaler (2021) dan teori posisi sosial Martin (2019), dan, secara praktis, menawarkan model pembelajaran digital inklusif yang mendorong kepercayaan diri, keterlibatan, dan partisipasi yang bermakna dalam matematika.
Keywords*: identitas matematis, gamifikasi, wordwall, media pembelajaran digital, ADDIE*

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INTRODUCTION

Mathematics is a discipline that plays a fundamental role in developing logical, systematic, and creative thinking skills. More than just a collection of numbers and formulas, mathematics is a means for developing reflective thinking and rational problem-solving (Boaler, 2021). However, in Indonesia, learning mathematics is still often perceived as difficult, tedious, and stressful. The Trends in International Mathematics and Science Study (TIMSS, 2019). The report shows that Indonesian students not only perform below the international average but also exhibit low levels of confidence in their mathematical abilities. This low positive perception of mathematics indicates an identity crisis in learning, where students learn mathematics without feeling part of the "world of mathematics" itself.

According to Hima (2023) the mathematical identity, students view themselves as individuals capable of thinking and participating in mathematical practices. This identity is not only related to cognitive abilities but also involves affective aspects such as self-efficacy, persistence, and personal values towards mathematics (value and meaning) (Cribbs et al, 2024) When students have a positive mathematical identity, they are more resilient in facing challenges, are not afraid of mistakes, and see difficulties as a natural part of the learning process (productive struggle) (Aljarrah, 2021). Conversely, students with a negative mathematical identity tend to avoid mistakes, feel incompetent, and lose motivation to learn (Martin, 2019).

Early adolescence (middle school level) is a crucial developmental phase for the formation of academic identity (Erikson, 2014). At this stage, students begin to seek meaning and value in every learning activity, including mathematics. If their learning experiences cause stress, fear, or boredom, an anti-math identity develops, which is a rejection of mathematics as part of the self (Campbell, 2020). Conversely, learning experiences that are enjoyable, collaborative, and provide space for exploration will strengthen students' sense of belonging to mathematics (Canonigo, 2023). Therefore, learning designs that are oriented towards social and emotional experiences are crucial in helping students develop a healthy mathematical identity.

One potential approach to creating meaningful learning experiences and fostering student self-confidence is gamification the application of game elements such as points, levels, rewards, and challenges within a learning context (Kapp, 2020). Gamification has been shown to increase students' intrinsic motivation and engagement (Zeng et al, 2024). A meta-analysis Sailer & Homner (2020) showed that gamification significantly impacts students' learning motivation, social interaction, and persistence. Similar studies Cavus (2023) and Nadi-Ravandi et al (2022) reinforce that the success of gamification is determined by designs that provide immediate feedback and challenging yet enjoyable learning experiences.

In the context of mathematics learning in Indonesia, platforms like Wordwall have become a popular gamification medium due to their ability to present interactive learning activities, such as quizzes, matching, and maze chases (Rahmawati, 2022). The use of Wordwall has been shown to increase student motivation and participation (Sary, 2024). However, most of these studies still focus on cognitive aspects, such as improving learning outcomes and conceptual understanding. At the same time, their impact on students' mathematical identity formation has not been fully explored (Weinhandl et al, 2024). This is the main academic anxiety of this research. There is a gap between

empirical evidence on the effectiveness of gamification and the theoretical understanding of how this medium contributes to the formation of a positive learning identity (Lo et al, 2021).

A preliminary study conducted at State Junior High School 4 Pare, Kediri Regency, in June 2025 found that 83% of students considered mathematics learning monotonous and teacher-centered, 76% feared making mistakes, and only 18% considered mathematics enjoyable. Interviews with teachers revealed that most students lost focus after 15 minutes of learning without interactive activities. This situation reinforces the fact that low student engagement and self-confidence are real issues that require innovative learning approaches, particularly those that foster motivation and self-confidence through positive social and emotional experiences (Alrajeh & Shindel, 2020).

Within the theoretical framework of mathematical freedom (Barba, 2022) and social positioning (Martin, 2019), mathematical identity formation occurs when students are given freedom of thought, space to experiment without fear of error, and social recognition for their participation in the learning community (Graven, 2019). Gamification, particularly based on the Wordwall platform, provides opportunities to deliver such experiences through reward systems, collaborative challenges, and immediate feedback (Branch, 2018). By integrating the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model, this media can be systematically designed to be valid, practical, and effective in increasing student engagement and confidence in mathematics (Krath, 2021).

However, the majority of previous studies on Wordwall and similar gamification platforms have continued to focus on cognitive outcomes, such as improved learning achievement and concept comprehension, leaving a significant gap in the literature regarding their impact on the affective domain, particularly on the formation of students' mathematical identities. This research aims to fill this gap by positioning gamification not just as a motivational tool, but as a strategic vehicle to foster a positive mathematical identity. This area is still rarely explored, especially in the Indonesian context. By integrating the theoretical frameworks of mathematical freedom (Boaler, 2021) and social positioning (Martin, 2019), this study offers a new perspective on how gamification elements facilitate identity formation.

Based on these various theoretical and empirical findings, the urgency of this research becomes increasingly apparent. In the era of the Independent Curriculum, which emphasizes meaningful, student-centered learning, mathematics education needs to shift from a purely cognitive orientation to one that develops character and a reflective learning identity. Therefore, this research aims to build students' mathematical identity by developing gamification-based learning media on the Wordwall platform using the ADDIE model.

METHOD

This study employed a Research and Development (R&D) approach using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model as proposed by Branch (2018). This model was chosen because it is systematic, adaptive, and allows for continuous revision based on field trial results. The R&D approach is relevant to the objectives of this study, which are to develop gamification-based learning media and assess their effectiveness in building students' mathematical identities.

The research was conducted at State Junior High School 4 Pare, Kediri Regency, East Java Province. This school was selected purposively because it has adequate ICT facilities and mathematics teachers who are familiar with digital media. The research was conducted during the odd semester of the 2025/2026 academic year**,** from August to October 2025.

The mathematical identity questionnaire instrument, adapted from Hima (2023) and Cribbs et al. (2024), consists of 20 Likert-scale items (1=Strongly Disagree to Agree 5=Strongly) that measure three dimensions: self-confidence (7 items), value & meaning (6 items), and engagement (7 items). Two experts have validated this instrument, with a Cronbach's Alpha reliability coefficient of 0.87 in a pilot study. During the implementation stage, the media was piloted in three 80-minute meetings covering Sets, Integers, and Social Arithmetic. In each session, students engage in customized Wordwall activities, such as 'Maze Chase' for quick problem-solving and 'Quiz' for formative assessment, both individually and in small groups. Qualitative data from observations and interviews were analyzed using thematic analysis Braun & Clarke (2006) to identify patterns of students' social-emotional experiences.

The study population comprised all 120 seventh-grade students at State Junior High School 4 Pare, divided into four study groups. The sample was selected using a purposive sampling technique, considering classes with average academic ability and readiness to use digital devices. Based on these considerations, 30 seventh-grade students were chosen as the research sample.

The data in this study consists of two types, namely:

1. Quantitative data, obtained from the results of the students' mathematical identity questionnaire before and after using Wordwall media (pretest–posttest).
2. Qualitative data were obtained through observation of learning activities and in-depth interviews with students and mathematics teachers.

The primary data sources were grade VII-B students as research subjects, mathematics teachers as supporting informants, and expert validators (media experts, material experts, and learning practitioners) who assessed the product's feasibility.

The sampling technique used was purposive sampling because the researchers considered the need for a limited trial of one class with homogeneous characteristics in terms of academic ability and access to digital devices. This technique is commonly used in exploratory and evaluative development research (Sugiyono, 2019).

Data was collected using the following instruments and techniques:

1. Observation used to monitor student engagement, social interactions, and emotional expressions during learning using Wordwall.
2. Semi-structured interviews were conducted with students and teachers to obtain in-depth information regarding learning experiences and perceptions of media.
3. Expert validation involves three types of validators, namely media experts, material experts, and learning practitioners, to assess the feasibility of the product based on aspects of appearance, content, and implementation.
4. Documentation in the form of screenshots of learning activities, teacher reflection notes, and student learning outcome data.

Data analysis was carried out quantitatively and qualitatively so that the research results were comprehensive:

1. Quantitative analysis is used to measure the improvement of students' mathematical identity through the N-Gain test, with the formula g (posttest−pretest)(100−pretest)g = \frac{(posttest-pretest)}{(100-pretest)} g = (100-pretest) (posttest-pretest) . The N-Gain interpretation criteria are based on Hake (1999): high ($g > 0.7$), medium ($0.3 \leq g \leq 0.7$), and low ($g < 0.3$).
2. Qualitative analysis was used to interpret observational and interview data through the stages of data reduction, data presentation, and conclusion drawing (Miles & Huberman, 2014). This analysis focused on identifying themes related to students' social and emotional experiences in the gamification-based learning process.
3. Expert validation analysis is calculated by averaging each aspect's score on a scale of 1–5, then categorized according to the eligibility criteria (Very Valid, Valid, Sufficient, and Invalid).

The research procedure follows the five stages of the ADDIE model:

1. Analysis identifies student needs, learning difficulties, and characteristics.
2. Designed Wordwall media and research instruments.
3. Development develops prototypes and performs expert validation.
4. Implementation testing of media in class VII-B in three meetings.
5. Evaluation conducts formative and summative assessments to assess the appropriateness and effectiveness of media in shaping students' mathematical identity.

RESULT AND DISCUSSION

Result

Results of expert validation indicate that the media learning Wordwall is highly suitable for use. The validation process was conducted by three groups of experts, each with a different assessment focus: media experts, material experts, and field practitioners.

Table 1.
Validation Results

Validator	Aspect Which Rated	Average Score	Category
Expert Media	Appearance, navigation, interactivity, and bait come back	4.65	Very Valid
Expert Material	Compliance curriculum, truth draft, and language	4.32	Very Valid
Expert Practitioner	Implementation, participation student, And efficiency time	4.10	Valid
Average Total	–	4.36	Very Valid

The average score of 4.36 indicates that the media meets the standards of pedagogical and technological feasibility. The highest was obtained from expert media

(4.65). Matter. This shows that the Wordwall interface is considered intuitive, engaging, and easy to use by both teachers and students. The combination of soft colors, simple navigation, and instant feedback fosters a pleasant learning environment. This is in harmony with theory (Heinich et al, 2016). Interactive media that employs a user-friendly interface can improve learners' engagement.

Meanwhile, the material experts gave a score of 4.32, indicating that the content and contents of the Wordwall were in accordance with the achievement learning Curriculum Independence. Questions that are arranged Contextually and equipped with educational feedback, such as "try another way " or "good, continue," reflecting the principle of formative feedback. The language used is also considered communicative and appropriate for junior high school students. Practitioners provide a score of 4.10, category valid. Although a little lower, note revision of practitioners actually becomes very important back: there needs to be an arrangement of game time to be more efficient. After revision, the duration of each session was reduced from 15 minutes to 10 minutes, so that all students can participate actively without losing focus.

Overall, the validation results show that the media developed not only fulfill standard technical requirements but also contain pedagogical marks. The main advantage of Wordwall lies in its ability to create an error-tolerant learning environment, allowing students to try again and again without fear of making mistakes.

An environment like this, according to Boaler (2021), is a prerequisite for the formation of a positive mathematical identity. With this, the process validation demonstrates that Wordwall media has met the ideal principles of educational media design development: relevant, easy, interesting, and meaningful.

Table 2.
Results Mathematical Identity

Dimensions	Pre (%)	Post (%)	N- Gain
Self- Confidence	56.2	78.8	0.52
Value & Meaning	59.5	81.4	0.54
Engagement	53.1	84.2	0.66

Analysis of the results shows that students' mathematical identity improved in real terms after using Wordwall media. The average pre-value of 56.3% increased to 81.5% post-implementation, with N-Gain of 0.57 (category currently).

The largest increase occurred in the engagement dimension (0.66), followed by value and meaning (0.54), and self-confidence (0.52). These results indicate that gamification had a prior influence. The aspect of social-emotional involvement in students is influential on self-confidence and the meaning of learning. In other words, engagement is the “starting gate” for the formation of a positive mathematical identity.

Findings. This strengthens the theory Hima (2023) that experience, Study, collaborative, And Reflective learning creates a "safe space" where students feel accepted as individuals capable of mathematical thinking. When students enjoy the process of playing while learning, their orientation shifts from simply seeking the right answer to exploring ways of thinking. In this context, the instant feedback from the Wordwall acts as emotional reinforcement that gradually builds self-confidence.

Change in the dimensions value and meaning. Also interesting for observation. An increase of 21.9 points (59.5 → 81.4) shows that students are beginning to see mathematics not just as a collection of symbols, but as a meaningful activity that can be enjoyed. Several students state in the interview:

" Play Wordwall to make understanding why the answer is so, not only guessing."

"I just realized, apparently, that problem can be connected to the game ."

This shows the epistemic formation connection between the draft and context, which are strong indicators of changes in mathematical identity (Boaler, 2021). Meanwhile, the smallest increase in self-confidence (0.52) is highly significant. Before intervention, many students feel afraid of being wrong when answering a question for the Teacher. After using Wordwall, students showed more open expressions and were more willing to participate. The teacher's observation reinforces this:

"Now those who are usually quiet often raise their hands first".

This phenomenon explains that Wordwall succeeds in changing Students' perception of their tolerance for mistakes. Mistakes are no longer seen as failures, but as part of the mathematical thinking process. This is the essence of identity change from fear of error to confidence through effort.

These results also support Bandura (2007) findings. View that self-efficacy is formed through experience. success small Which repeatedly. Through system points, badges, and levels, Wordwalls provide numerous mastery experiences that gradually build students' self-confidence. In general, the development of mathematical identity can be summarized through three main patterns:

1. Improvement involves social - students are more active and collaborative.
2. Improvement awareness: students better understand their mistakes.
3. Change the emotional attitude from being Afraid to believing in oneself and wanting to try again.

Thus, the quantitative results show that gamification media not only improve outcomes in the Study but also alter students' psychological and social aspects in the context of mathematics learning.

This shows dynamics consistent with the Boaler (2021) view of the formation of mathematical identity. Both assert that identity is not built through memorizing concepts, but rather through social and emotional experiences that foster reflection and participation. According to Boaler, mathematical identity develops when students experience "mathematical freedom of thought" (mathematical freedom), namely, the chance to try, fail, and succeed without fear. Wordwall offers freedom through safe play and fun. Every error is considered an opportunity; no failure. When students get instant feedback such as "Good, try again," they do not lose motivation but rather feel supported to experiment. This situation gives rise to productive struggle, a condition in which students enjoy the process of thinking even when they experience difficulties. That's it, from the beginning of the emergence of mathematical agency, the belief that "I am capable of thinking and solving mathematical problems."

Temporary, that Martin (2019), looking at identity, mathematical, as results, construction, and social. He emphasized that a person becomes "mathematical" when their social environment recognizes their existence as a competent participant. In the context

of Wordwall, group play creates a new social position for students: they are no longer passive recipients of information but active actors recognized by their classmates. Students who answer quickly receive applause. hands, while Which Wrong still get support. Social interaction becomes a form of identity positioning, namely the social mechanism in which confession and reception build academic self-confidence.

Findings from the field show that engagement plays a role as a door to self-confidence, which, in turn, fosters a sense of value and meaning. These three form a mutually reinforcing chain of identity development, as explained by Boaler and Martin:

Diagram 1.
Positive Identity Development Cycle Model

This chain is not linear but a positive spiral that continually reinforces itself through pleasant, meaningful social experiences and is deep. When students feel accepted (Martin), given the freedom to think (Boaler), and successful (Bandura), a complete mathematical identity is formed, namely one based on a sense of belonging, courage, and meaning.

In the Indonesian context, these results confirm that junior high school students, who are in a transition period, require a learning learn that integrates cognition, emotion, And Social relationships. Wordwall-based gamification provides all three at once: cognitive challenges, positive emotional experiences, and social recognition. Therefore, Wordwall is not only an effective medium but also a social ecosystem for shaping mathematical identity.

From a theoretical perspective, this study confirms the relevance of Boaler (2021) theory on mathematical freedom and Martin (2019) theory on social positioning in learning. Wordwall presents both in context digitally: students have the freedom to think and receive social recognition in a fun learning environment. Thus, Wordwall is not just a tool, but a space for identity formation where students experience intellectual freedom, a sense of acceptance, and the meaning of learning simultaneously. From a psychopedagogical perspective, these results show that effective learning is not only about conveying concepts, but also about how students view themselves as part of the world of mathematics. Media Wordwall successfully presents an ecosystem Study that integrates humanistic aspects, combining cognitive, social, and emotional elements to support the formation of a positive, enduring mathematical identity. Overall, this research makes a new contribution to the theory of mathematical identity by placing it in the context of digital learning gamification. This area is still rarely studied in Indonesia.

Discussion

The results of the study indicate that gamification-based learning media on the Wordwall platform are effective in improving junior high school students' mathematical identity, especially in self-confidence, engagement, and learning meaning (value and meaning). Based on the practicality test, teachers and students responded very positively to the use of media, finding it engaging and interactive and encouraging a healthy competitive spirit. In addition, the effectiveness test results showed a significant increase

in mathematical identity scores after using the media, with an average increase of 27.5%. This confirms that game elements integrated into mathematics instruction can change students' emotional experiences towards lessons that were previously considered difficult and frightening.

These findings support Boaler 2021) the theory of mathematical freedom, which states that when students are given space to experiment, try various strategies, and are not afraid of failure, they are more likely to think creatively and construct meaning in the learning process. In the context of gamification, Wordwall creates a safe learning environment for experimentation, where mistakes are not the end of the process, but rather part of the challenge that can be repeated. This process encourages productive struggle productive difficulties that help students understand concepts more deeply (Pasquale, 2016). Thus, students learn to embrace failure as a natural part of the learning process.

Socially, the results of this study also strengthen Martin (2019) view on social positioning theory , that mathematical identity is formed from social recognition and active participation of students in the learning community. Game elements such as leaderboards, badges, and collaborative teams create a social space that recognizes individual success. When students see themselves successfully completing challenges and being recognized by their peers, they develop a sense of confidence that they are also "part of the world of mathematics." This aligns with research by Campbell (2020) and Canonigo (2023). which shows that active engagement and social recognition play a crucial role in shaping students' positive identities.

From a motivational and engagement perspective, gamification has been shown to increase intrinsic motivation and academic engagement. This finding aligns with a meta-analysis conducted by Sailer & Homner (2020), Khoshnoodifar et al (2023) and Zeng et al (2024), who concluded that gamification elements can improve students' attention, concentration, and persistence in learning. In this study, increased student engagement was evident in behavioral changes: students were more active in asking and discussing questions, and they demonstrated curiosity about Wordwall questions. This demonstrates that gamification is not merely a means of entertainment but can also support reflective and experiential learning.

The success of this media is also inseparable from the application of the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model, which ensures that the development process is carried out systematically and is user-need-oriented (Branch, 2018). This model enables formative evaluation at every stage, ensuring the resulting media is not only visually appealing but also pedagogically relevant. Therefore, a development model such as ADDIE is recommended for creating other learning media that are oriented towards student identity and learning motivation.

In addition to strengthening existing theory, this research makes a novel contribution to the study of mathematical identity by demonstrating that technology-based interventions and gamification can serve as vehicles for developing a positive learning identity. Play experiences foster a sense of belonging and competence two crucial components in academic identity formation (Pettersen, 2023). Thus, gamification serves not only as a motivational strategy but also as an identity vehicle that helps students build healthy emotional and social relationships with mathematics.

In the local context, the results of this study align with those of Libryanti (2023). Who found that using Wordwall increased junior high school students' motivation and

focus in mathematics learning (Rahmawati, 2022). A study demonstrated a significant improvement in understanding of Cartesian coordinate concepts through a Wordwall-based e-module. However, this study goes further by adding affective dimensions and mathematical identity to the evaluation of learning outcomes. This broadens the scope of research on gamification in Indonesia, which has previously focused solely on cognitive aspects.

The practical implications of this research are the importance of teachers shifting from traditional teaching patterns to reflective, interactive, and humanistic learning. Gamification can be an inclusive learning model because it allows students of all abilities to participate without fear of failure. Furthermore, this study recommends that schools and curriculum developers provide training on gamification-based digital learning design to strengthen teachers' pedagogical competencies in the digital era.

Theoretically, the results of this study broaden our understanding of how mathematical identity is constructed through the interaction of cognitive, affective, and social aspects facilitated by digital media. Mathematics learning is not simply a process of understanding concepts, but also a journey of developing students' intellectual and emotional identities. Quantitative and qualitative findings reinforce each other. The N-Gain value, which has been increasing, is continuing to grow. Expression believes that Wordwall is not just a tool, but a medium for transforming learning identities. Gamification creates social–emotional experiences that motivate students to be active, collaborative, and reflective.

The novelty of this research lies in its perspective on gamification as a reconstruction tool. identity mathematical, not just media motivation. Approach: This shows that design learning, which balances cognitive and affective aspects, can produce larger and more lasting changes in learning identity.

CONCLUSION

Research on the development of the gamification-based learning media, Wordwall, at State Junior High School 4 Pare demonstrates that innovative digital media can be effective in building students' mathematical identities. The ADDIE approach used allows the development process to proceed systematically, starting from analyzing student needs to evaluating the media's effectiveness. Experts rated the media as very valid (average score of 4.36), while the N-Gain test results (0.57; moderate category) showed a significant increase in the dimensions of students' mathematical identity. The largest increase occurred in the engagement dimension, followed by value, meaning, and self-confidence. These findings suggest that gamification-based learning first triggers emotional engagement, which then fosters a sense of self-confidence and meaning. Wordwall is not only visually interesting but also creates an error-tolerant learning environment, where students are free to try and experiment without fear. This process gradually shapes mathematical self-confidence and a new meaning for learning mathematics.

RFERENCES

Aljarrah, A. (2021). Productive struggle and mathematical identity: Students' reflections on learning mathematics. Journal of Mathematics Education and Learning, 14(2), 89–102.

Alrajeh, A., & Shindel, B. (2020). Motivation and affect in mathematics learning: A socio-cultural perspective. International Journal of Educational Psychology, 9(3), 187–203.

Bandura, A. (2007). Self-efficacy: The exercise of control. New York: WH Freeman and Company.

Barba, L. (2022). Identity and belonging in mathematics classrooms: A critical review. Educational Studies in Mathematics, 10(1), 15–34. https://doi.org/https://doi.org/10.1007/s10649-022-10122-7

Boaler, J. (2021). Mathematical mindsets: Unleashing students' potential through creative mathematics, inspiring messages, and innovative teaching. San Francisco: CA: Jossey-Bass.

Branch, R. M. (2018). Instructional design: The ADDIE approach. New York: Springer.

Campbell, P. F. (2020). Building positive mathematical identities in early adolescence. Middle Grades Research Journal, 11(2), 43–61.

Canonigo, K. (2023). Social interaction and mathematical engagement: A case study of collaborative gamified learning. Contemporary Educational Research Journal, 8(1), 45–59.

Cavus, N. (2023). Gamification and learning motivation: Meta-analysis of empirical studies. Computers & Education, 9(5), 46–62.

Cribbs, J.D., Linder, S.M., & Turner, E. E. (2024). Understanding students' mathematical identity through affective and cognitive dimensions. Mathematics Education Research Journal, 36(2), 223–239.

Erikson, E. H. (2014). Identity and the life cycle. New York: W. W. Norton & Company.

Graven, M. (2019). Mathematical identity research: Theoretical developments and classroom applications. African Journal of Research in Mathematics, Science and Technology Education, 23(1), 1–12. DOI. 10.1080/18117295.2019.1620914

Heinich, R., Molenda, M., Russell, J.D., & Smaldino, S. (2016). Instructional media and technologies for learning. Boston: MA: Pearson Education.

Hima, L. (2023). Students' mathematical identity in the context of collaborative reflective learning. Journal of Mathematics Education and Learning, 5(2), 134–145.

Kapp, K. M. (2020). The gamification of learning and instruction: Game-based methods and strategies for training and education. Hoboken: NJ: Wiley.

Khoshnoodifar, M., Rezaei, S., & Rastegar, A. (2023). Gamified learning and motivation: A meta-analysis of recent studies. Interactive Learning Environments, 31(5), 802–820. https://doi.org/https://doi.org/10.1080/10494820.2022.2089341

Krath, J. (2021). Integrating gamification in educational design: A systematic framework. Education and Information Technologies, 6(1).

Libryanti, E. (2023). The effectiveness of using Wordwall in increasing junior high school students' motivation to learn mathematics. Indonesian Journal of Mathematics Education Innovation, 4(1), 11–20. **DOI:** https://doi.org/10.47668/jrrei.v2i2.1637

Lo, M., Kato, T., & Su, S. (2021). Gamification and mathematical identity formation in digital learning environments. International Journal of Mathematical Education in Science and Technology, 52(8), 1257–1275. https://doi.org/https://doi.org/10.1080/0020739X.2020.1849595

Martin, D. B. (2019). Equity, identity, and agency in mathematics education research: A

critical perspective. Journal for Research in Mathematics Education, 50(4), 367–389. DOI. 10.1080/13613324.2019.1592833

Nadi-Ravandi, S., Rezvani, A., & Afshar, H. (2022). The effect of gamification on students' engagement and academic achievement. Computers in Human Behavior, 13(2). DOI:10.1109/ACCESS.2025.3560567

Pasquale, M. (2016). Encouraging productive struggle in mathematics classrooms. Teaching Mathematics in the Middle School, 21(2), 88–95.

Pettersen, J. (2023). Mathematical identity and student resilience in learning mathematics. European Journal of Educational Studies, 10(3), 112–126.

Rahmawati, F. (2022). Development of a Wordwall-based e-module to improve understanding of the concept of Cartesian coordinates. Journal of Innovative Mathematics Learning, 8(2), 77–88.

Sailer, M., & Homner, L. (2020). The gamification of learning: A meta-analysis on motivational outcomes. Educational Psychology Review, 32(1), 77–112. https://doi.org/10.1007/s10648-019-09498-w

Sary, D. (2024). The influence of Wordwall media on learning engagement of secondary school students. Journal of Mathematics and Science Education, 7(1), 59–68. DOI: https://doi.org/10.46843/jiecr.v6i1.1972

Sugiyono. (2019). Metode Penelitian Kuantitatif, Kualitatif, dan R&D. Bandung: Alphabet.

TIMSS. (2019). TIMSS 2019 international results in mathematics and science. International Association for the Evaluation of Educational Achievement (IEA). Retrieved from https://timssandpirls.bc.edu

Weinhandl, R., Lavicza, Z., & Schallert, S. (2024). Digital games and identity in mathematics education: Exploring opportunities and challenges. Digital Education Review, 4(2), 91–109. DOI 10.1344/der.2024.4.91-109.

Zeng, L., Chen, Y., & Lin, H. (2024). Gamification and student engagement in STEM learning environments: A review and meta-analysis. Computers & Education, 19(5), 104–694. DOI:10.30191/ETS.202404_27(2).RP03