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Motivation in learning mathematics among high school students in Ningbo, China

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Abstract

Motivation plays a crucial role in enhancing students' achievement in mathematics, as motivated students are more likely to engage actively with the subject. However, in China, there is a concerning trend of declining motivation among students toward mathematics, with many exhibiting avoidance behaviors. Despite Ningbo's significance as a major city in China, there is a lack of studies and surveys addressing students' motivation in mathematics learning. This study addresses this gap by employing a questionnaire based on Keller's ARCS (Attention, Relevance, Confidence, Satisfaction) model, which has been proven effective in measuring students' motivation. The survey, conducted among 384 high school students in Ningbo, China, aimed to assess their motivation levels in mathematics learning. Descriptive statistical analysis was performed using SPSS Statistics 29 to calculate the mean and percentage for each item. The results revealed that the motivation level among high school students in Ningbo is notably low. Two significant factors contributing to this low motivation were identified: students' lack of confidence due to the perceived difficulty of mathematics and the belief that mathematics is not closely related to real life.

Keywords: ARCS Model, China, High School, Mathematics, Motivation

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Motivation is a pivotal factor in determining students' mathematical performance (Karakis et al., 2016). Numerous studies have underscored the critical role of motivation in shaping mathematical achievement (Fuqoha et al., 2018; Ning, 2020; Tran & Nguyen, 2021; Wong & Wong, 2021). Motivated students tend to focus more effectively and excel in mathematical tasks, showing increased resilience, particularly when confronted with complex concepts (Arroyo et al., 2014). It is essential to maintain and foster students' motivation in mathematics education (Schukajlow et al., 2017). This can be achieved by emphasizing the application of mathematical concepts in real-world contexts and nurturing an intrinsic motivation for learning mathematics (Fuqoha et al., 2018).

China has consistently exhibited outstanding performance in the Program for International Student Assessment (PISA) tests. In the 2018 PISA assessment, which encompassed four major cities (Beijing, Shanghai, Jiangsu, and Zhejiang) and included 600,000 students, China ranked first in all three subjects among 79 participating countries and education systems (Strauss, 2019). However, research by Gokhale (2019) revealed that high PISA scores do not necessarily correlate with high levels of student motivation. Unfortunately, the current situation in China reflects a significant lack of motivation among students to engage with mathematics, with many actively avoiding the subject (Ng, 2018; Zhang et al., 2023). Zhang et al. (2023) examined the motivation levels of senior secondary school students, analyzing data from 623 Chinese students over two years. The findings indicated that these students exhibited a combination of intrinsic and extrinsic motivation but did not demonstrate a profound commitment to learning mathematics. The predominant exam-oriented education system in China may contribute to a decline in student motivation, offering insight into why Chinese students, despite their strong numeracy skills, may struggle with complex, open-ended problems (Cai et al., 2020). Some students perceive mathematics as irrelevant to daily life, influenced by the belief that it lacks practical applications. Nevertheless, Chinese teachers place significant emphasis on enhancing student motivation, often recognizing the importance of demonstrating the real-world applications of mathematics, with some asserting that students' interest in mathematics increases when they understand its practical relevance (Wang Xinjing, 2022).

As one of China's earliest coastal cities to open its ports to the outside world, Ningbo has historically served as both a strategic point for the interaction between Chinese and Western cultures and a window for projecting China's national image internationally (Li, 2019). In recent years, the setters of China's high school entrance examination questions have increasingly aligned with global academic trends, drawing on advanced concepts from the Program for International Student Assessment (PISA) to incorporate real-world contexts into test questions. This approach aims to assess students' ability to apply mathematics as a tool for solving practical problems. In Ningbo, it is explicitly mandated that PISA-style questions constitute a certain proportion of the high school entrance examination. Within the framework of curriculum standards and examination guidelines, the mathematics exam questions are innovatively designed to reflect the principles underlying PISA questions (Liu, 2021). Different motivational constructs have been identified as significant predictors of PISA competencies (Gjicali & Lipnevich, 2021; Kriegbaum et al., 2015). Ningbo is currently implementing the revised Chinese mathematics curriculum standards introduced in 2022, which aim to enhance students' motivation to learn mathematics. Given that two years have passed since these new standards were implemented, it is essential to evaluate the extent to which this objective has been achieved. However, there is a notable lack of studies and surveys on the motivation of Ningbo students in learning mathematics. Investigating this aspect is crucial, as it could prompt further scholarly attention toward education in Ningbo.

A widely utilized model for understanding motivation in education is the Attention, Relevance, Confidence, and Satisfaction (ARCS) model (Li & Keller, 2018; Zabala-Vargas et al., 2022). Developed by Keller (1984), the ARCS model is organized around four key components: attention, relevance, confidence, and satisfaction (as illustrated in Figure 1). These dimensions are crucial in influencing students' motivation throughout the mathematics learning process (Khakpour et al., 2016). The ARCS model is underpinned by the expectancy-value theory (Keller, 1987), which provides its theoretical foundation. Beyond its role in instructional design, the ARCS model is also a valuable tool for assessing the impact of educational materials on motivation, having been effectively applied for over four decades (Dincer, 2020).

The attention component seeks to engage learners by employing diverse teaching methods and presentation styles (Izmirli & Izmirli, 2015). One effective strategy for capturing students' attention in mathematics classes is to present content in varied formats, such as utilizing computer software, videos, or group activities, to maintain their motivation (Novak, 2014). For the relevance aspect, it is essential for teachers to connect mathematics lessons to their future applicability (Izmirli & Izmirli, 2015). Strategies to enhance relevance may include relating the mathematics curriculum to real-life issues, addressing learners' educational needs, linking current content to future requirements, clearly articulating objectives, encouraging group work, and offering individualized attention to learners (Milman & Wessmiller, 2016). Demonstrating the relevance of mathematics enhances motivation by helping students understand how it connects to other subjects, thereby fostering a deeper comprehension of why mathematics is essential to their education.

For the confidence aspect, students' self-efficacy is bolstered when they feel confident about initiating and completing a mathematics task, as this encourages them to take personal responsibility for their learning (Hodges & Kim, 2013). Emphasizing what students can achieve and focusing on their strengths and abilities helps build their confidence. Providing opportunities for students to apply their learning and showcase their work allows them to experience a sense of accomplishment (Milman & Wessmiller, 2016). The satisfaction component centers on students' feelings towards the mathematics tasks they have completed. Personal satisfaction is derived from the pride and fulfillment a student feels upon successfully completing a mathematics task (Izmirli & Izmirli, 2015; Keller, 2009).

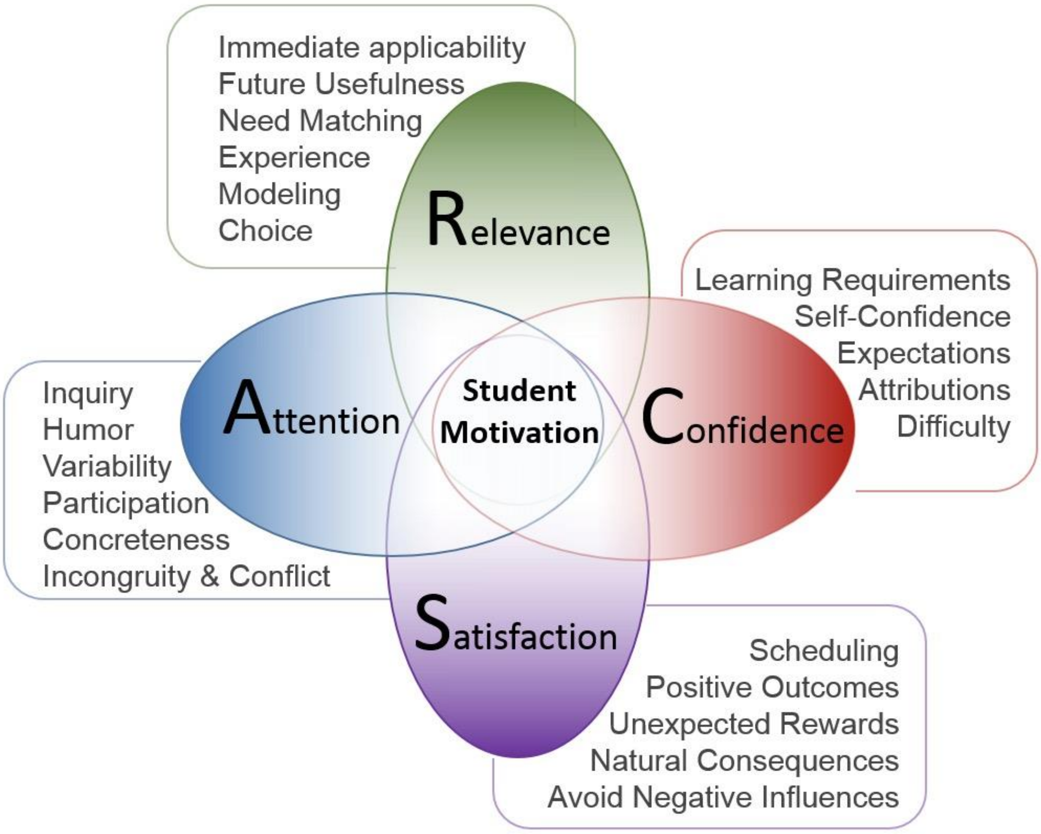

Figure 1. ARCS motivation model

(Note: Figure 1 adapted from "Model of Motivation: ARCS Instructional Design" by Dr. Serhat Kurt posted on Education Library on January 30, 2021, and updated on October 17, 2022.)

In recent years, the ARCS model has been employed in various studies to assess its effectiveness in enhancing learning motivation, often yielding positive results (Chang & Chen, 2015). Numerous researchers have developed questionnaires based on the ARCS model to evaluate students' motivation in learning mathematics, demonstrating its efficacy as a measurement tool (Bakar et al., 2010; Hsu, 2020;

Wong & Wong, 2021). Accordingly, the objective of this research is to assess the level of motivation among high school students in Ningbo, China, using the ARCS model as a framework.

1. Students' attention towards mathematics learning
2. The relevance of the mathematics learning
3. Students' confidence towards mathematics learning
4. Students' satisfaction towards mathematics learning

METHODS

Research Design

The ARCS motivation model is utilized to design the questionnaire for a motivation survey aimed at identifying students' motivation levels in learning mathematics (Hsu, 2020; Sahanata & Dewi, 2022; Wong & Wong, 2021). This motivation survey was administered among high school students in Ningbo. Student surveys are currently among the most widely employed methods in empirical educational research for evaluating instructional quality (Herbert et al., 2022).

Sampling

In 2023, Ningbo, Zhejiang Province, China, had 85 ordinary high schools with a total of 103,000 students. For this study, a sample of 384 students from 6 high schools in Ningbo was selected based on the Morgan table. Stratified sampling was employed to ensure representation across different grades within the six schools. The researcher obtained permission from each school to collect the questionnaires and ensured that students were informed about the anonymity of the survey and the confidentiality of their personal information. Participation was voluntary, with consent obtained from each student. The participants, aged 16 to 18 years, included 167 boys and 217 girls, spanning from the first to the third year of high school. Out of the 384 distributed questionnaires, 292 valid responses were collected.

Data Collection and Data Analysis

In this study, data were gathered through a motivation survey designed to assess high school students' motivation levels in learning mathematics. A questionnaire based on the ARCS model was administered to 384 students from six high schools in Ningbo. The survey utilized a 5-point Likert scale (1 = 'strongly disagree' to 5 = 'strongly agree') with response options including Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree. The reliability and validity of the questionnaire were evaluated using Cronbach's Alpha (Cα) and expert assessment, with a value of α greater than 0.7 indicating strong reliability. The questionnaire's α coefficient in this study was 0.944, demonstrating high reliability. Each scale's reliability is detailed in Table 1.

Table 1. Cronbach's reliability analysis test

Scale Name	Number of items	Cronbach's α
Attention	6	0.865
Relevance	5	0.845
Confidence	6	0.802
Satisfaction	5	0.874
Total	22	0.944

The questionnaire, reviewed by two experts, was refined to include 22 items measuring students' attention, confidence, and satisfaction with mathematics learning, as well as the relevance of mathematics to students. The items were categorized as follows: six items for "Attention," five items for "Relevance," five items for "Confidence," and six items for "Satisfaction." Descriptive analysis of the collected data was conducted, with means and percentages for each item calculated using SPSS software.

RESULTS AND DISCUSSION

Table 2 presents the percentages and means for each response choice across the four scales and the overall motivation. The results show that the overall mean of students' motivation in learning mathematics was 2.80, which falls below the neutral threshold of 3.0. Additionally, the means for each individual scale were also below 3.0, with the "confidence" scale showing the lowest mean of 2.63, as depicted in Figure 3. These findings suggest that students' motivation for learning mathematics is relatively low.

Table 2. Distribution of percentage and mean scores on the questionnaire scale

Scale	Percentage (%)					Mean
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
Attention	9.3	28.3	34.0	23.3	5.1	2.87
Relevance	10.0	28.1	35.2	22.6	4.1	2.83
Confidence	15.9	31.3	30.9	17.3	4.6	2.63
Satisfaction	11.7	23.0	39.0	21.2	5.1	2.85
Overall motivation	11.6	27.5	34.9	21.2	4.8	2.80

The distribution of responses shows that the percentage of students who selected "strongly disagree" was higher than those who selected "strongly agree" for each scale. Additionally, the percentage of students who chose "disagree" exceeded those who chose "agree." Overall, 39.1% of students provided negative responses regarding their motivation, while only 26% offered positive responses. Specifically, for the "confidence" scale, 47.2% of students expressed negative (31.3%) or highly negative (15.9%) views, whereas only 21.9% expressed positive (17.3%) or highly positive (4.6%) views on their confidence in learning mathematics presented in Figure 2.

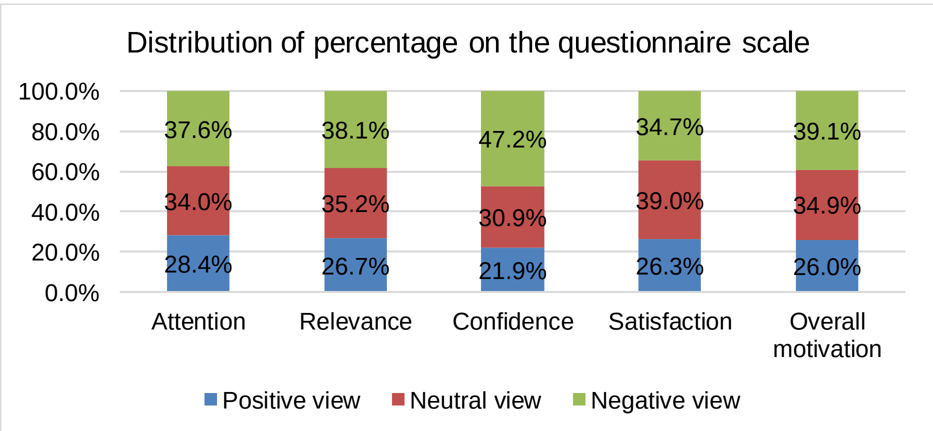

Figure 2. Distribution of percentage on the questionnaire scale

These results collectively indicate that students' motivation to learn mathematics is at a low level. A comprehensive analysis and discussion of the items within each scale will be provided in the Results and Discussion section.

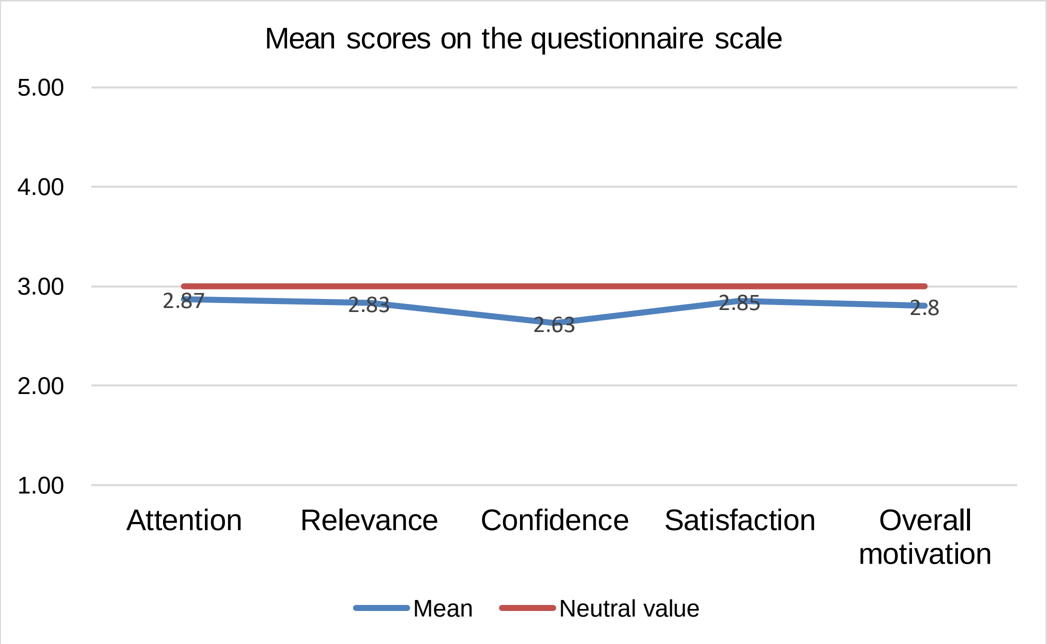

Figure 3. Mean scores on the questionnaire scale

Attention

Table 3 presents the statistical results for the "attention" scale. The overall mean for this scale was 2.87. Among the six items, five had means below 3.0, with only Item 1 achieving a mean of 3.05. These results suggest that students generally do not exhibit high levels of attention during mathematics classes.

Table 3. Statistical results for question items on "attention"

Item	Percentage (%)					Mean
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
1	6.5	26.4	29.1	31.8	6.2	3.05
2	9.6	28.8	34.2	22.3	5.1	2.85
3	10.3	19.9	44.9	20.9	4.1	2.89
4	11.3	36.6	34.2	14.0	3.8	2.62
5	11.0	28.8	29.1	24.7	6.5	2.87
6	7.2	29.5	32.2	26.0	5.2	2.92
Total	9.3	28.3	34.0	23.3	5.1	2.87

Specifically, Item 1, which states, "The problems presented during learning mathematics inspired my curiosity," and Item 2, "The problems presented during learning mathematics were very interesting to me," were designed to assess students' perceptions of the problems presented in mathematics classes. Although Item 1 had a mean of 3.05, indicating a slightly higher level of attention, Item 2 had a mean of 2.85, below the neutral threshold of 3.0. This indicates that while students did not find the problems presented in mathematics class overly dull, these problems did not significantly stimulate their curiosity.

Figure 4 clearly illustrates that the overall results of the survey on "attention" were predominantly negative, with Item 4 showing particularly low scores. Only Item 1, "The problems presented during learning mathematics inspired my curiosity," received a slightly positive response. Approximately 37.6% of students reported a low level of attention during mathematics lessons, with 9.3% indicating that mathematics classes were entirely unappealing and that they struggled to focus.

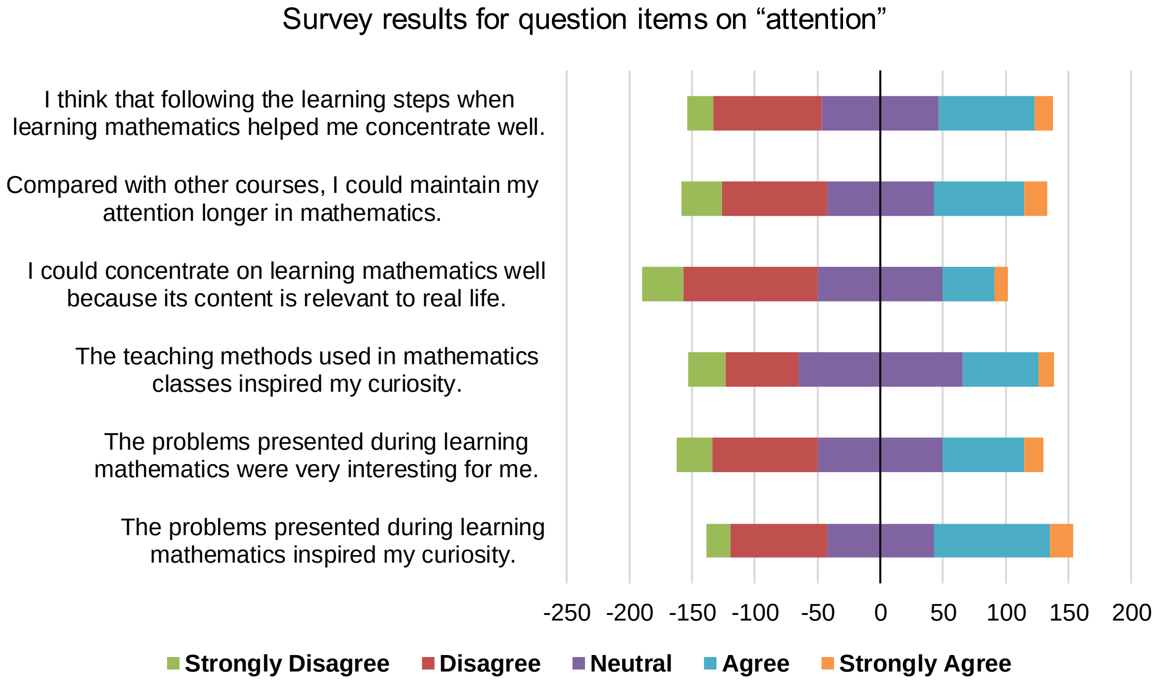

Figure 4. Survey results for question items on "attention"

For all items, the percentage of students selecting "strongly disagree" was higher than those choosing "strongly agree." Additionally, for four out of the six items, the percentage of students responding "disagree" exceeded those responding "agree." Although Items 1 and 3 had more "agree" responses than "disagree," the overall trend remained negative. Item 4, "I could concentrate on learning mathematics well because its content is relevant to real life," recorded the most negative result, suggesting that the perceived relevance of mathematics problems to real life significantly affects students' attention. These findings indicate that students' attention to mathematics classes is low. Students who do not perceive the relevance of mathematics to real-life situations are likely to regard math-related activities as meaningless, which contributes to their lack of attention (Mumcu, 2018).

Relevance

Table 4 presents the statistical results for the "relevance" scale. The overall mean for this scale was 2.83, indicating a level below the neutral threshold of 3.0. Furthermore, each individual item within this scale also had a mean lower than 3.0, suggesting that students generally struggled to perceive the relevance of mathematics to other contexts.

Item 7, "I could connect the problems/issues with mathematics knowledge," had the lowest mean of 2.69, while Item 10, "I could find the relevance between mathematics and real life," also recorded a low mean of 2.82. These results collectively indicate that students find it challenging to relate mathematics to real-life situations and fail to recognize a clear connection between mathematical concepts and real-world problems.

Table 4. Statistical results for question items on "relevance"

Item	Percentage (%)					Mean
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
7	13.0	30.1	35.3	18.2	3.4	2.69
8	11.0	26.0	30.1	28.1	4.8	2.90
9	8.9	24.7	38.4	23.6	4.5	2.90
10	10.3	28.4	35.6	20.9	4.8	2.82
11	6.8	31.2	36.6	22.3	3.1	2.84
Total	10.0	28.1	35.2	22.6	4.1	2.83

Figure 5 clearly illustrates that the survey results regarding the "relevance" scale were predominantly negative across all items. The data reveal that 38.1% of students held negative (28.1%) or highly negative (10%) views on the relevance of mathematics to their lives, surpassing the 26.7% of students with positive views. This pattern mirrors the trends observed in the "attention" scale, where the percentage of "strongly disagree" responses exceeded that of "strongly agree" for all items.

Among the items, only Item 8, "I could connect the content of mathematics with the content that I have learned before," received more "agree" responses than "disagree" responses. Items 8, 9, and 11 addressed students' perspectives on the relevance of different areas of mathematics knowledge, while Items 7 and 10 focused on the relevance between mathematics and real-life situations. The results suggest that students find it more challenging to relate mathematics to real-life contexts than to identify connections within mathematical knowledge itself. The findings underscore the importance of integrating real-life problems into mathematics instruction. Without such integration, students may struggle to see mathematics as a practical tool for daily life (Mumcu, 2018; Pechočiak & Kecskés, 2016).

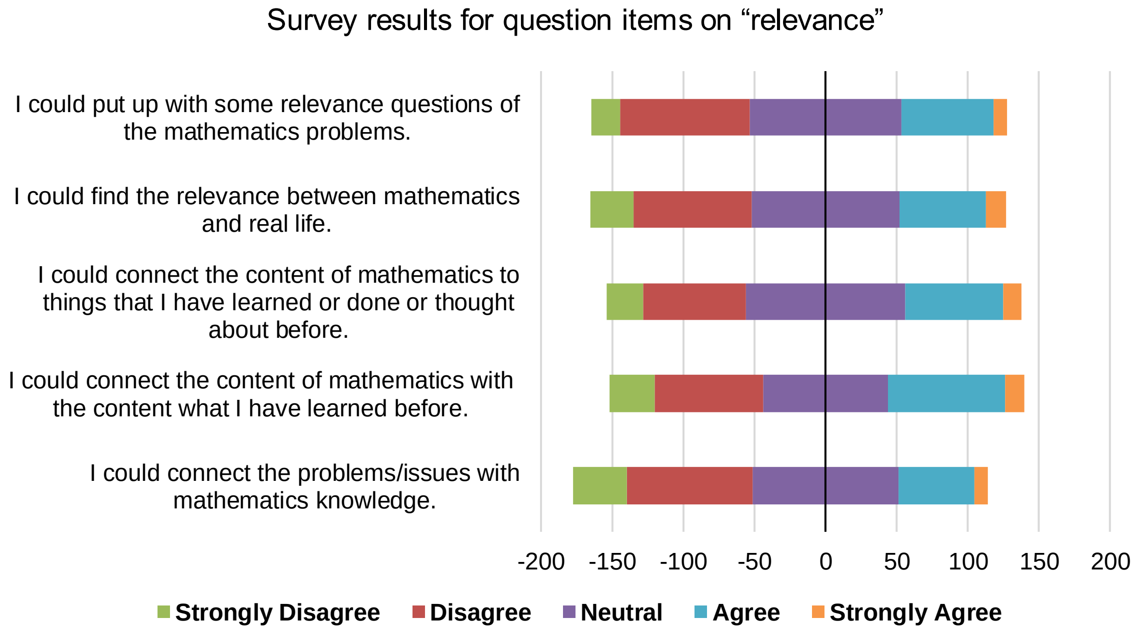

Figure 5. Survey results for question items on "relevance"

Confidence

Table 5 presents the statistical results for the "confidence" scale, which recorded the lowest overall mean of 2.63 among the four scales. This suggests a significant lack of confidence among students in their mathematics learning. Specifically, Item 15, "The content of mathematics is not difficult for me," had the lowest mean of 2.21, indicating that students perceive mathematics content as challenging. Conversely, Item 14, "I feel confident when I can solve mathematics problems," had the highest mean of 3.06, exceeding the neutral threshold of 3.00.

Table 5. Statistical results for question items on "confidence"

Item	Percentage (%)					Mean
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
12	17.1	35.3	36.0	9.6	2.1	2.44
13	9.6	25.7	37.3	22.6	4.8	2.87
14	7.5	27.1	25.7	31.2	8.6	3.06
15	30.1	33.9	25.3	6.5	4.1	2.21
16	15.1	34.6	30.1	16.8	3.4	2.59
Total	15.9	31.3	30.9	17.3	4.6	2.63

These results highlight a critical issue: while students struggle with the perceived difficulty of mathematics content, their confidence improves when they successfully solve problems. This underscores the need for instructional strategies that build students' confidence through successful problem-solving experiences. Addressing students' difficulties and providing opportunities for achievement can enhance their confidence in learning mathematics.

Figure 6 illustrates those four out of five items on the "confidence" scale lean towards negative responses, with three items showing distinctly negative results and one item reflecting a slightly positive outcome. Nearly half of the students (47.2%) reported a lack of confidence in learning mathematics. Notably, Item 14, "I feel confident when I can solve mathematics problems," received more positive responses (39.8%) compared to negative responses (34.6%), indicating that successful problem-solving plays a crucial role in boosting students' confidence.

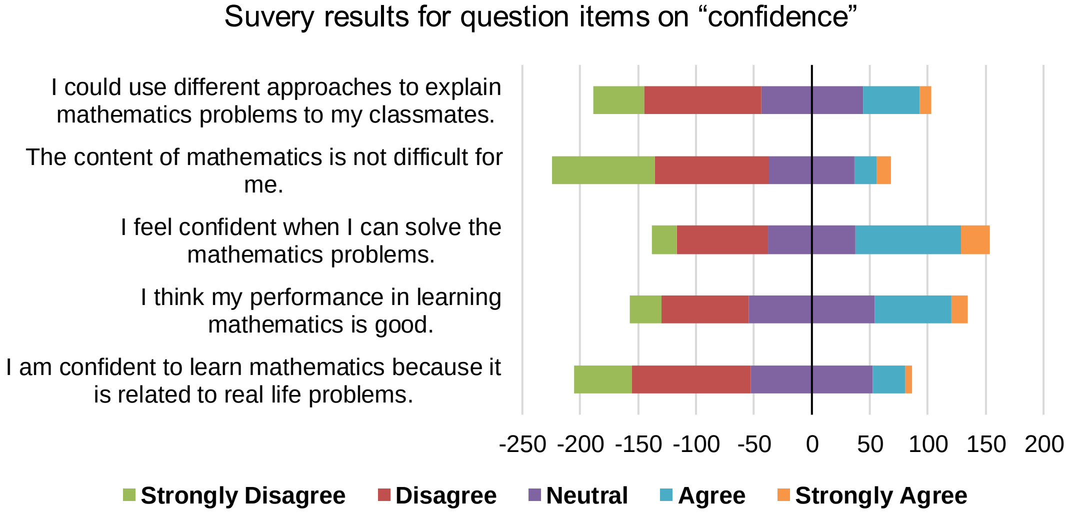

Figure 6. Survey results for question items on "confidence"

Item 15, “The content of mathematics is not difficult for me,” had the highest percentage of “strongly disagree” responses among all five options and was the only item with such a high proportion of negative responses. This underscores the significant challenge students face with the perceived difficulty of mathematics, which adversely affects their confidence. Mazana et al. (2018) observed that difficulty in mathematics can lead to diminished confidence. Furthermore, the negative responses to Item 12, “I am confident to learn mathematics because it is related to real-life problems,” were notably higher than the positive responses, with over half of the answers being negative (52.4%). This, combined with the results from the “attention” and “relevance” scales, highlights a prevalent perception among students that mathematics is not effectively connected to real-life situations, further undermining their confidence and motivation.

Satisfaction

Table 6 presents the statistical results for the “satisfaction” scale. The overall mean of 2.85 is below the neutral threshold of 3.0, and all individual item means are similarly below this threshold. These results indicate a general dissatisfaction among students with their mathematics learning experiences.

Specifically, Item 17, “I like to learn mathematics very much and hope to have the opportunity to learn more about it,” received the lowest mean of 2.73. This suggests that students have had negative or unsatisfactory experiences with mathematics learning, leading to reduced enthusiasm and expectations for future mathematics instruction. This dissatisfaction can contribute to a cycle where students perform below expectations, lose interest in mathematics, and may ultimately disengage from further learning in the subject. Lopes and Soares (2024) highlight that students' satisfaction is a key factor influencing their motivation, reinforcing the importance of addressing students' dissatisfaction to improve their overall motivation and engagement in mathematics.

Table 6. Statistical results for question items on “satisfaction”

Item	Percentage (%)					Mean
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
17	16.1	23.6	37.3	17.5	5.5	2.73
18	11.6	21.9	38.7	24.3	3.4	2.86
19	7.5	24.7	43.8	20.2	3.8	2.88
20	10.6	24.7	35.6	22.3	6.8	2.90
21	12.7	22.6	39.4	19.9	5.5	2.83
22	11.6	20.5	39.0	23.3	5.5	2.90
Total	11.7	23.0	39.0	21.2	5.1	2.85

Figure 7 illustrates that the results for all items on the “satisfaction” scale were generally negative, though the extent of negativity was not excessively pronounced. Specifically, 26.3% of the responses were positive, which was lower than the 34.7% of negative responses across this scale. Notably, the percentage of "strongly disagree" responses exceeded the percentage of "strongly agree" responses for each item.

However, for two items, the percentage of "agree" responses was higher than the percentage of "disagree" responses. Item 18, "The content of mathematics and the way of explanation make me feel that it is worth learning," and Item 22, "Completing the goals of mathematics classes gives me satisfaction," received a relatively higher proportion of positive feedback. This suggests that while students generally expressed dissatisfaction with their mathematics learning experiences, they did not view the teaching methods or the achievement of learning objectives as entirely negative. These findings indicate that while overall satisfaction is low, certain aspects of the teaching process and goal achievement are perceived more favorably by students.

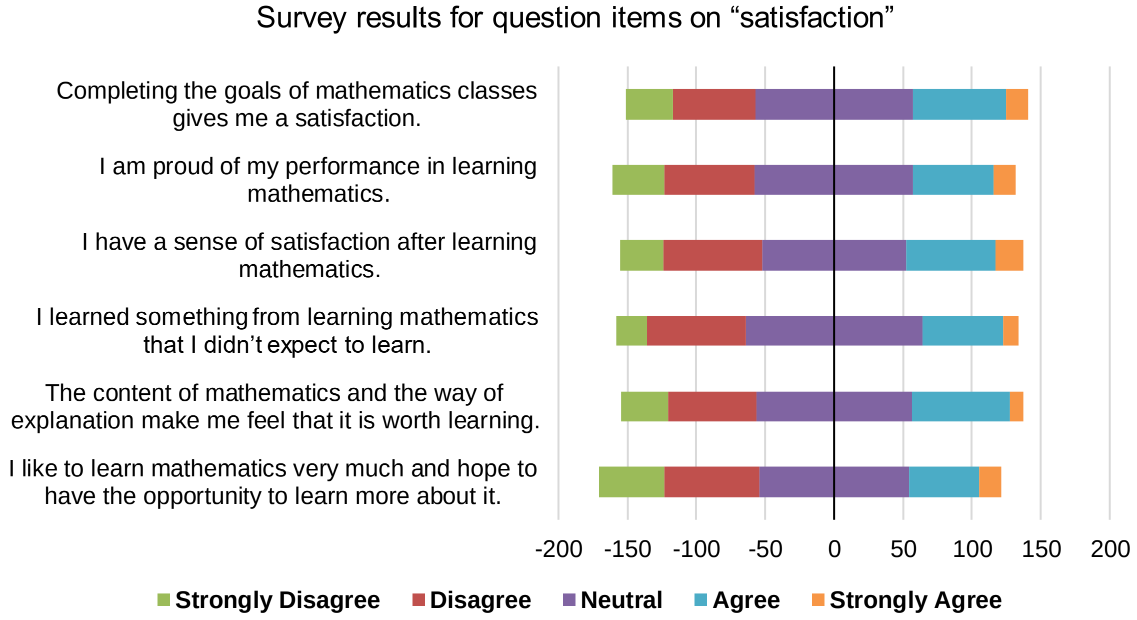

Figure 7. Survey results for question items on "satisfaction"

The analysis of the data reveals a uniformly low level of motivation among students across all dimensions of the ARCS model. Specifically, the overall motivation and each individual dimension of attention, relevance, confidence, and satisfaction show consistently negative results. The mean scores for 20 out of 22 items fell below the neutral value of 3.0, with negative responses surpassing positive ones in percentage terms for these items. This indicates a general lack of enthusiasm and engagement in mathematics learning among the students surveyed.

The findings suggest that the current classroom practices may not be effectively capturing students' attention. According to Hanus and Fox (2015), insufficient strategies to engage students can contribute to low motivation. Additionally, the ARCS model highlights the importance of making learning content relevant to students' personal interests and future aspirations. Huang et al. (2019) argue that when students perceive the material as pertinent to their goals, their motivation tends to increase. Building students' confidence in their mathematical abilities is also crucial, as emphasized by Jossberger et al. (2020), and ensuring that students derive satisfaction from their learning experiences is vital for sustaining motivation, as noted by Imran (2023). These aspects collectively underscore the need for improved instructional strategies that address attention, relevance, confidence, and satisfaction to enhance student motivation in mathematics.

The discrepancy between the high academic performance of Chinese students in the 2018 PISA assessments and their low motivation levels, as observed in this study, underscores the complexity of educational dynamics in China. Despite achieving top rankings in international assessments, the low motivation levels reported among students in this study reflect a multifaceted interplay of educational practices and cultural influences.

Chinese students are under significant pressure from various sources, including parents, teachers, and societal expectations, which drives them to excel academically. This external pressure often motivates students to perform well on standardized tests and maintain high academic standards, even if their intrinsic interest or motivation in specific subjects, such as mathematics, is limited (Qian & Lau, 2022; Yang & Fan, 2023). The Chinese education system, which emphasizes rote memorization and exam-oriented learning, tends to prioritize test performance over deep engagement with the subject matter. While this approach can yield impressive results in standardized tests, it may not nurture a genuine passion for learning or a profound understanding of the material (Tao, 2016).

Moreover, in Chinese culture, education is highly esteemed, and academic success is closely linked to future career prospects and social status. This cultural value can propel students to achieve high performance metrics, yet it might not necessarily align with their personal interests or intrinsic motivations. This cultural emphasis on achievement often results in a disconnect between students' performance and their actual motivation levels (Bardach et al., 2020; Guo & Leung, 2021). Consequently, the observed low motivation among high school students in Ningbo aligns with the broader context of China's educational system and cultural expectations, highlighting a gap between academic success and personal engagement in learning.

CONCLUSION

The high school students' motivation in mathematics in Ningbo was notably low. Among the ARCS motivation model's four scales, students' confidence in learning mathematics was the most adversely affected. The responses to the five items within this scale indicated that a significant factor contributing to the lack of confidence was the perception of mathematics content as overly difficult. However, students were able to build some degree of confidence through successful problem-solving experiences.

The traditional Chinese educational culture, which views the teacher as the primary disseminator of knowledge and regards mathematics as an absolute source of truth, often leaves little room for compromise or negotiation. This perspective, coupled with a strong examination culture that emphasizes score-oriented learning, exerts substantial pressure on students and educators alike (Wang et al., 2018). Chinese teachers frequently face the expectation to cover a large amount of content within limited class time, driven by the high-stakes nature of examinations (Yang et al., 2021). This examination-centric approach and teacher-centered classroom environment restrict opportunities for students to explore mathematical concepts independently or engage in collaborative learning. As a result, the rigid structure of the mathematics curriculum and the overwhelming emphasis on content coverage leave students with minimal chances to develop confidence in their mathematical abilities. The limited scope for independent exploration and peer interaction further diminishes students' confidence and motivation in mathematics.

Another crucial finding from this study is that students perceived mathematics as having limited connections to real life. In the scales of "attention," "relevance," and "confidence," items addressing the relevance of mathematics to real-life situations received notably low mean scores. Students generally disagreed with the notion that their past experiences with mathematics made clear connections to real-world contexts, which in turn affected their ability to focus and feel confident in mathematics classes.

In contemporary mathematics education, it is essential to recognize that learning extends beyond the mere acquisition of mathematical knowledge. The ability to apply mathematical literacy, scientific literacy, and reading skills to real-life situations has become increasingly significant, as highlighted by the PISA project (Ozgen, 2019). Roberts et al. (2018) and Abramovich et al. (2019) emphasize that integrating real-life applications into mathematics education can enhance student motivation. This heightened motivation not only improves performance but also influences overall achievement and the practical application of mathematics in daily life (Wakhata et al., 2022). Thus, enhancing the connection between mathematics and real-life applications is critical for boosting students' motivation in learning mathematics.

Finally, the findings indicate that the current motivation levels among high school students in Ningbo are alarmingly low and necessitate immediate attention. Shifting from traditional, teacher-centered approaches to more student-centered teaching methods and strengthening the relevance of mathematics to real-life contexts are essential strategies for addressing this issue. This paper advocates for further research into these areas, particularly using the ARCS motivation model, to develop effective solutions and improve students' motivation in mathematics.

Declarations

Author Contribution	:	HM: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Validation, Visualization, Writing - original draft, and Writing - review & editing. ZI: Conceptualization, Methodology, Resources, Supervision, Validation, and Writing - review & editing. NI: Supervision, Resources, and Writing - review & editing. HX: Resources and Validation.
Funding Statement	:	No funding
Conflict of Interest	:	The authors declare no conflict of interest.
Additional Information	:	All information is available for this paper.

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