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Fostering Mathematical Motivation with Wordwall Media: A Study of the ARCS Model (Attention, Relevance, Confidence, and Satisfaction) Based on Sex Among High School Students

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ABSTRACT

This research is motivated by concerns about low student motivation in the educational environment. The main objectives of this study are: 1) to understand the level of motivation among the majority of high school students in Lebak Banten Regency in learning mathematics using the Wordwall media; 2) to explore differences in the level of student motivation based on the ARCS model in mathematics learning utilizing the Wordwall media, considering sex factors; 3) to analyze the percentage of each ARCS aspect contributing to the level of motivation in mathematics learning using the Wordwall media; 4) to identify how the percentage of each ARCS aspect affects the level of motivation in mathematics learning using the Wordwall media, considering sex differences; 5) to examine the influence of Wordwall-based mathematics learning on sex-based motivation seen from the ARCS model. The research method used is quantitative with a quasi-experimental approach and a One-Group Pretest-Posttest research design. The data analysis results show that female students' motivation tends to be higher than that of male students, with the motivation percentage of female students being higher in each aspect of ARCS motivation. The Satisfaction aspect has the highest percentage, which is 78.53%. There is a significant increase in the motivation of male and female students from pretest to posttest. The increase is seen in all four aspects of ARCS motivation. In male students, there is an increase from an average of 47.36% to 75.00%, while in female students, there is an increase from 54.25% to 83.16%. Additionally, there is an influence before and after Wordwall-based mathematics learning based on sex seen from the ARCS model

ABSTRAK

Penelitian ini dilatarbelakangi oleh kekhawatiran terhadap rendahnya motivasi belajar siswa dalam lingkungan pendidikan. Tujuan utama dari penelitian ini adalah: 1) memahami tingkat motivasi di antara mayoritas siswa SMA di Kabupaten Lebak Banten dalam pembelajaran matematika menggunakan media Wordwall; 2) mengeksplorasi perbedaan tingkat motivasi siswa berdasarkan model ARCS dalam pembelajaran matematika dengan memanfaatkan media Wordwall, dengan mempertimbangkan faktor jenis kelamin; 3) menganalisis persentase dari setiap aspek ARCS yang berkontribusi terhadap tingkat motivasi dalam pembelajaran matematika menggunakan media Wordwall; 4) mengidentifikasi bagaimana persentase dari setiap aspek ARCS memengaruhi tingkat motivasi dalam pembelajaran matematika menggunakan media Wordwall,

dengan mempertimbangkan perbedaan sex; 5) meneliti pengaruh pembelajaran matematika berbasis Wordwall terhadap motivasi berdasarkan sex yang dilihat dari model ARCS. Metode penelitian yang digunakan adalah kuantitatif dengan pendekatan eksperimen semu dan desain penelitian One-Group Pretest-Posttest. Hasil analisis data menunjukkan bahwa motivasi siswa perempuan cenderung lebih tinggi daripada siswa laki-laki, dengan persentase motivasi siswa perempuan yang lebih tinggi dalam setiap aspek motivasi ARCS. Aspek Kepuasan memiliki persentase tertinggi, yaitu 78,53%. Terdapat peningkatan signifikan dalam motivasi siswa laki-laki dan perempuan dari pretest ke posttest, yang terlihat pada keempat aspek motivasi ARCS. Pada siswa laki-laki, terjadi peningkatan dari rata-rata 47,36% menjadi 75,00%, sedangkan pada siswa perempuan, terjadi peningkatan dari 54,25% menjadi 83,16%. Selain itu, terdapat pengaruh sebelum dan sesudah pembelajaran matematika berbasis Wordwall berdasarkan sex yang dilihat dari model ARCS.

INTRODUCTION

Understanding mathematics is often considered difficult and challenging for most students at various educational levels (Sholichah & Aini, 2022; Putri & Hakim, 2022; Yulianto, 2020). This is unsurprising because mathematics requires a deep understanding of abstract concepts and problem-solving skills that require precision and accuracy (Putri & Hakim, 2022; Yulianto, 2022). In the process of learning mathematics, learning motivation plays a crucial role (Akmalia & Ulfah, 2021). Learning motivation influences how actively students engage in learning, how hard they work to understand mathematical concepts, and how resilient they are to challenges in solving mathematical problems (Handayani et al., 2021).

A deep understanding of learning motivation in mathematics education is important because: 1) Learning motivation can be a determining factor in students' success in understanding mathematical concepts (Sihombing et al., 2021) and encouraging them to solve mathematical problems more diligently (Akmalia & Ulfah, 2021). 2) Learning motivation affects students' perseverance levels in facing difficulties in mathematics learning (Liberna & Seruni, 2022), so motivated students will be better able to overcome obstacles with high spirit and determination (Sukarno & Salamah, 2019). 3) Understanding learning motivation enables educators to design effective learning strategies (Yanti, 2020), by creating a supportive learning environment that encourages students to reach their optimal learning potential in mathematics (Yulianto, 2023). This idea underscores the necessity for educators to prioritize and nurture learning motivation to enhance mathematical achievement and resilience in students.

Learning motivation is recognized as a critical component in the educational process, particularly in mathematics education (Yanti, 2020). It originates from intrinsic factors but is often spurred by specific goals and external stimuli (Fitriah, 2018). High learning motivation enhances student engagement and academic performance, especially in challenging subjects like mathematics (Zanthy, 2016; Sholichah & Aini, 2022). Previous studies have highlighted the importance of learning motivation in fostering perseverance and overcoming difficulties in mathematics (Liberna & Seruni, 2022; Sukarno & Salamah, 2019). Additionally, effective learning strategies that consider motivational aspects can significantly improve educational outcomes (Yulianto, 2023).

Recent research has emphasized various aspects of learning motivation. Sihombing et al. (2021) and Akmalia & Ulfah (2021) have shown that motivation is crucial for understanding and solving mathematical problems. Liberna & Seruni (2022) and Sukarno & Salamah (2019) found that motivated students are more resilient when facing challenges in mathematics. Moreover, Yanti (2020) and Yulianto (2023) highlighted the role of learning motivation in designing effective instructional strategies and creating supportive learning environments. Despite the extensive research on learning motivation, there remains a need to explore its application in specific local contexts, such as in Lebak Banten Regency. Additionally, the influence of sex on learning motivation in mathematics, particularly through the ARCS model, is underexplored. Previous studies have not fully addressed how different elements of the ARCS model (Attention, Relevance, Confidence, Satisfaction) specifically impact mathematics learning motivation at the high school level, nor how these elements interact with sex differences (Rahmah et al., 2023; Yulianto, 2023).

The educational context in Lebak Banten Regency presents unique challenges, including economic constraints, ethnic and cultural diversity, and limited learning resources (Rismawati & Khairiati, 2020; Yulianto et al., 2024). These factors can negatively affect students' motivation and perceptions of mathematics. Moreover, the sex differences in learning motivation have not been sufficiently analyzed, especially regarding the use of innovative learning media like Wordwall. This study aims to address these gaps by adopting the ARCS model to measure and analyze student motivation in mathematics learning, utilizing Wordwall as an engaging learning tool. The ARCS model's elements (Attention, Relevance, Confidence, Satisfaction) will be examined to understand their individual and combined effects on student motivation, with a focus on sex differences.

The research aims to achieve the following objectives: 1) Assess the overall level of motivation among high school students in Lebak Banten Regency in mathematics learning using Wordwall; 2) Explore sex differences in learning motivation using the ARCS model; 3) Analyze the contribution of each ARCS element to student motivation; 4) Determine how each ARCS element influences mathematics learning motivation considering sex differences; 5) Evaluate the impact of Wordwall-based learning on sex-specific motivation in mathematics. By addressing these objectives, the study hopes to provide insights into effective strategies for enhancing learning motivation in mathematics, making the educational process more inclusive and tailored to the needs of all students.

METHOD

This research uses a quantitative method with a quasi-experimental approach of comparative descriptive type. The research design employed is the One-Group Pretest-Posttest, without involving a control group. The purpose of this research design is to compare the students' motivation outcomes before and after the learning process. The research design scheme can be seen in Table 1.

Table 1. Research Design Scheme

T1	X	T2

Note:

T_1: pretest (before treatment)

T_2: posttest (after treatment)

X: Treatment Wordwall-based learning

The population focused on in the study is high school students (Grade XI) in Lebak-Banten Regency, totaling 112 schools with a subject population of 17,437 students, both from public and private schools. The source of school data can be found in Table 2 and the link https://www.umm.ac.id/id/pages/banten.html.

Table 2. Number of Schools in Banten Province

The regions in Banten Regency	Senior High School (SMA/MA)			Vocational High School (SMK)		
	Negeri	Swasta	Total	Negeri	Swasta	Total
Lebak Regency	30	58	88	5	19	24
Pandeglang Regency	21	64	85	7	35	42
Serang Regency	30	116	146	9	52	61
Tangerang Regency	75	176	251	10	100	110
Cilegon City	7	32	39	2	10	12
Serang City	6	-	6	-	-	-
Tangerang City	17	86	103	6	87	93
Tangerang Selatan City	-	-	-	-	-	-
Total	**186**	**532**	**718**	**39**	**303**	**342**

The researchers did not use the entire existing population, but instead, a sample representing the entire population (Representative) in Lebak-Banten Regency was taken. In determining the sample of public high schools (SMA/MA/SMK) in Lebak-Banten Regency, the Cluster Random Sampling technique was used, where the sample chosen is not individuals but groups or areas, and the selected sample consists of the 11th-grade classes, which constitute 50% of all 11th-grade classes in public high schools (SMA/MA/SMK) in Lebak-Banten Regency, resulting in a population of 8,719 11th-grade students. The sampling technique to determine the number of students to be sampled used probability sampling (random sampling) using the Slovin formula with a margin of error of 5%. The Slovin formula can be expressed as follows:

$$n = \frac{N}{1 + Ne^2} = \frac{8.719}{1 + 8.719(0{,}05)^2} = \frac{8.719}{1 + 8.719(0{,}0025)} = \frac{8.719}{1 + 21.7975} = \frac{8.719}{22.7975} = 382{,}466$$

Where: n is the required sample size; N is the population size; e is the margin of error in decimal (in this case, 5% or 0.05). From the calculation of the Slovin formula with a 5% margin of error, the number of research subjects obtained is approximately 383 students, consisting of students from public high schools in Lebak Banten Regency, which will later be randomly selected from each school. The selection of schools is carried out through purposive random sampling by considering certain characteristics or variables that are deemed important or relevant. By using this method, researchers can save time and resources, ensure optimal representation of the population, and facilitate more focused data analysis and more accurate result generalization. Additionally, this method also allows researchers to have greater control over the factors that influence the research results.

The selected schools as samples are class XI, including: SMAN 1 has 13 classes (9 MIPA classes and 4 IIS classes), SMAN 2 has 9 classes (6 MIPA classes and 3 IIS classes), SMAN 3 has 9 classes (6 MIPA classes and 3 IIS classes), MAN 1 has 9 classes (2 Religious classes, 4 MIPA classes, and 3 IIS classes), MAN 2 has 9 classes (1 Religious class, 5 MIA classes, 3 IIS classes), SMKN 1 has 17 classes (5 Accounting classes, 3 Office Administration classes, 4 Multimedia classes, 3 Software classes, 2 Commerce classes), SMKN 2 has 12 classes (2 Culinary Arts classes, 4 Fashion classes, 4 Beauty classes, 2 Computer, and Informatics Engineering classes). To determine the classes, a lottery is conducted using rolled-up papers corresponding to the number of classes in each school. Papers with the word "sample" written on them are included in the lottery. Then, representatives from each school class gather to draw the rolled-up papers. The class that draws the paper with the word "sample" will be chosen as the sample for this study.

Table 3. Research Samples

Department	School Name							Total Subjects
	SMAN 1	SMAN 2	SMAN 3	MAN 1	MAN 2	SMKN 1	SMKN 2	
Science	22	24	20	32	32	–	–	130
Social Science	22	24	20	32	32	–	–	130

Department	School Name							Total Subjects
	SMAN 1	SMAN 2	SMAN 3	MAN 1	MAN 2	SMKN 1	SMKN 2	
Accounting	–	–	–	–	–	14	–	14
Administration	–	–	–	–	–	14	–	14
Multimedia	–	–	–	–	–	14	–	14
Software	–	–	–	–	–	12	–	12
Business	–	–	–	–	–	12	–	12
Culinary Arts	–	–	–	–	–	–	14	14
Fashion	–	–	–	–	–	–	14	14
Beauty	–	–	–	–	–	–	14	14
ICT	–	–	–	–	–	–	12	12
Total Subjects	44	48	40	64	64	66	57	383

The seven selected schools above, which were used as the subjects of the study, consist of eleventh-grade classes and mathematics teachers who have been instructed on how to utilize Wordwall media for teaching mathematics during the learning process. The teachers conducted the research for 8 sessions on the topic of statistics. The research instrument used in this study is a questionnaire. This research instrument, using a Likert scale, can be in the form of multiple-choice questions or checklists. Each question item in the questionnaire provides five available answer options, each with its score: 1, 2, 3, 4, and 5. The description of positive statement scores is as follows: a score of 5 is "Very Suitable for you (VS)," a score of 4 is "Suitable for you (S)," a score of 3 is "Sometimes suitable, sometimes not suitable for you (SS)," a score of 2 is "Not Suitable for you (NS)," and a score of 1 is "Not Suitable for you at all (NSA)." The description of negative statement scores is the opposite. The questionnaire instrument was distributed to students online via the Google Forms platform. The questionnaire instrument was designed based on Keller's 1987 ARCS Motivation Model, which includes four main aspects: Attention, Relevance, Confidence, and Satisfaction (Table 4).

Table 4. Grid of Student Learning Motivation Questionnaire

Aspect Learning Motivation	Indicator	Statement		
		Positive	Negative	Total
Attention	Rate of curiosity.	1	7	8
	Student involvement.	8	14	22
	Student interest.	10	2	12
Relevance	Relevance of the theme to the learning objectives and materials.	3	18	21
	Relevance of mathematics learning materials to student needs.	15	20	35
	Relevance of methods to the materials.	16	17	33
Confidence	Confidence in understanding the material.	13	4	17
	Confidence in taking quizzes.	19	11	30
Satisfaction	Understanding of the material.	5	9	14
	Learning outcomes.	12	6	18
Total		**102**	**108**	**210**

The validity calculation results of the questionnaire show that 200 out of a total of 210 statement items are considered valid, with the calculated r > r table (0.138). This indicates that the majority of statements in the questionnaire can be relied upon to measure student motivation based on the ARCS model in mathematics learning. The reliability of the motivation questionnaire test was measured using Cronbach's Alpha formula, and the reliability result is 0.938, interpreted as "very high". This indicates that the motivation questionnaire has a very good level of consistency in measuring student motivation toward mathematics learning. Data analysis was conducted using Microsoft Excel 2011 and IBM SPSS software for Windows version 24.0. Student learning motivation was classified into

five defined categories, as presented in Table 5. Using both software tools, student learning motivation data were explored, analyzed, and systematically presented according to the predetermined classification.

Table 5. Classification of Student Learning Motivation

Score Interval	Percentage (%)	Classification
851 – 1000	86 – 100	Very High
601 – 850	61 – 85	High
451 – 600	46 – 60	Medium
301 – 450	31 – 45	Low
200 – 300	21 – 30	Very Low

In this study, data collection techniques include administering an initial questionnaire to students to identify motivation and interest in learning mathematics before treatment, administering treatment to the class, and administering a final questionnaire to students after the treatment of the instructional model, all of which are viewed from a sex perspective. Data analysis uses two techniques:

a. Descriptive Statistical Analysis: Used to identify distribution characteristics and variable scores, such as mean values, standard deviation (S), maximum values, and minimum values. Then, questionnaire analysis is conducted to examine the percentage of each category of learning motivation using Equation 1:

$$A = \frac{N}{T} \times 100\%$$

Explanation:

A : The category of student learning motivation ranging from very high to very low, measured in percentage (%).
N : The number of students included in each category of learning motivation.
T : The total number of students or samples in the study.

To calculate the percentage of each aspect of the ARCS Motivation Model (Attention, Relevance, Confidence, and Satisfaction) from the data on the learning motivation questionnaire, Equation 2 is used.

$$M = \frac{X}{Y} \times 100\%$$

Explanation:

M : Percentage of each ARCS aspect.
X : Score of each aspect: A (Attention), R (Relevance), C (Confidence), and S (Satisfaction).
Y : Ideal score or criteria score of each aspect: A (Attention), R (Relevance), C (Confidence), and S (Satisfaction).

b. Inferential Statistical Analysis: The research hypotheses are tested using inferential analysis, with prior normality and homogeneity tests.
   1) Normality testing is conducted using the Kolmogorov-Smirnov test at a significance level of 5% or 0.05. If the significance value > α, the data is considered normally distributed, while if the significance value < α, the data is considered not normally distributed.
   2) Homogeneity testing is conducted using the Levene test at a significance level of 5% or 0.05. If the coefficient significance value > α, the data is considered homogeneous, while if the coefficient significance value < α, the data is considered not homogeneous.

After conducting the prerequisite tests, hypothesis testing is performed to examine whether there is an influence of Wordwall-based mathematics learning based on sex seen

from the ARCS model. This hypothesis testing uses the Paired-sample test to compare motivation scores before and after the treatment.

RESULTS AND DISCUSSION

The research was conducted at State High Schools/Vocational Schools in Lebak Banten Regency, by distributing questionnaires to students of grade XI from August to October in the second semester of the academic year 2023/2024 through the Google Forms platform. The total participants in this study were 383 students, with details of the number of students from each school listed in Table 6.

Table 6. Number of Research Subjects

School Name	Department	Total Subjects	
		Male	Female
SMA N 1	Science	8	14
	Social Science	12	10
SMA N 2	Science	10	14
	Social Science	16	8
SMA N 3	Science	10	10
	Social Science	12	8
MAN 1	Science	12	20
	Social Science	16	16
MAN 2	Science	14	18
	Social Science	17	15
SMKN 1	Administration	4	10
	Multimedia	6	8
	Software	12	2
	Business	12	-
	Culinary Arts	2	10
SMK N 2	Fashion	2	12
	Beauty	3	10
	ICT	-	10
	Administration	16	4
Total by Sex		**184**	**199**
Total Research Subjects		**383**	

From Table 6, it can be concluded that the total number of research subjects is 383, with the majority of them being female (199) compared to males (184). There is variation in the number of subjects based on the type of school and major. Schools with science majors tend to have more female students, while social science majors have a more dominant number of male students. However, there is significant variation in the number of male and female subjects in each school and major. The data from the mathematics learning motivation questionnaire can be seen in Table 7.

Table 7. Description of Mathematics Learning Motivation Data for High School Students in Lebak-Banten Regency.

Description	Result of Mathematics Learning Motivation Questionnaire	
	Pretest	Posttest
Sample size	383	383
Mean	491,05	818,41
Standard Deviation	12,86	21,43
Variance	165,46	459,06
Maximum value	294	490
Minimum value	632	958

From Table 7, it can be concluded that there is a significant increase in the motivation of high school students in the Lebak-Banten Regency after participating in mathematics learning based on the Wordwall media. Although there is variation in the increase in motivation among students, overall, the program or activity is effective in enhancing students' motivation to learn mathematics.

Table 8. Description of Student Learning Motivation per School

School Name	Pretest			Posttest		
	Mean	Std. Deviation	Variance	Mean	Std. Deviation	Variance
SMA N 1	506,28	12,14	154,40	843,80	21,43	459,11
SMA N 2	502,89	11,92	153,37	838,15	21,29	456,03
SMA N 3	477,06	11,31	145,49	795,10	20,20	432,61
MAN 1	494,04	11,71	150,67	823,40	20,91	448,01
MAN 2	480,75	11,39	146,61	801,25	20,35	435,96
SMK N 1	503,28	11,93	153,49	838,80	21,31	456,39
SMK N 2	473,04	11,21	144,26	788,40	20,03	428,96

Table 8 describes student learning motivation per school before (Pretest) and after (Posttest) the intervention was conducted. The average score of learning motivation increased from Pretest to Posttest in each school, indicating an improvement in student learning motivation after the intervention.

1. The Level of High School Students' Motivation in Lebak Banten Regency in Mathematics Learning Assisted by Wordwall Media Based on the ARCS Model.

The learning motivation questionnaire consists of 200 statements, each followed by four answer options according to the Likert scale. After calculation, a maximum score of 1000 points and a minimum score of 200 points are obtained. Table 8 shows the percentage classification of learning motivation overall.

Table 8. Percentage Classification of Learning Motivation

Test	Score Interval	Classification	Total Subjects	
			f	%
Pretest	851 – 1000	Very High	16	4,18
	601 – 850	High	100	26,11
	451 – 600	Medium	69	18,16
	301 – 450	Low	8	2,09
	200 – 300	Very Low	190	49,61
Total Subjects			383	100
Mean			491,05 (49,11%) Criteria "Medium"	
Posttest	851 – 1000	Very High	31	8,09
	601 – 850	High	199	51,96
	451 – 600	Medium	138	36,03
	301 – 450	Low	15	3,92
	200 – 300	Very Low	-	-
Total Subjects			383	100
Mean			818,41 (81,84%) Criteria "High"	

Based on Table 8, it can be concluded that there was a significant improvement in test results from the pretest to the posttest. The majority of students in the pretest were classified as having low and very low scores, but in the posttest, the majority of students had reached high and very high score classifications. The average score also increased substantially from 49.11% in the pretest to 81.84% in the posttest. This indicates that the learning program has successfully enhanced students' understanding of the tested material.

Based on the analysis results in Table 8, there is a significant change from pretest to posttest in the level of motivation based on the ARCS Model of high school students in Lebak Banten Regency in mathematics learning aided by Wordwall media. In the pretest, the majority of students (49.61%) were classified with very low scores, with an average score of 491.05 (49.11%). However, in the posttest, there was a significant improvement, with the majority of students (51.96%) reaching high score classification, and most students (36.03%) were in the moderate score classification. The average score also increased substantially to 818.41 (81.84%).

These results indicate that the mathematics learning program using Wordwall media has successfully increased students' learning motivation significantly. This study is in line with the findings reported by Launin et al. (2022), which showed that the use of the Wordwall application in learning could increase students' learning motivation by 59.75%. Another study by Walidah et al. (2022) also supports these findings by finding a positive impact of using the Wordwall application on learning motivation. Furthermore, Nissa & Novita (2021) concluded that the use of the Wordwall application could increase students' learning interest. This is consistent with the research conducted by Sari et al. (2021), which stated that there is an influence of using Android-based quiz game media (Wordwall) on the learning outcomes of grade X students in SMA N 2 Lubuk Basung. Then the research conducted by Arimbawa (2021) stated that the implementation of Wordwall quiz games could increase motivation and learning achievement in biology. Another study by Nafi'ah (2021) stated that the implementation of a card sort model based on Wordwall in the tajweed subjects could gradually increase students' learning activities and learning outcomes from 70.38% in Cycle I to 92.59% in Cycle II.

Learning media is one of the most important factors in the field of education. Learning with appropriate media will provide optimal results for students' understanding of the material they are studying (Mardhiah & Akbar, 2018; Kanda, 2020). According to Tobamba et al. (2019), media is a tool used by a teacher for learning activities. Furthermore, according to Audia et al. (2021), learning media is a tool to accelerate the delivery of material in learning. All of these indicate that the use of the Wordwall application in learning has the potential to increase students' learning motivation. The implementation of the Wordwall application in mathematics learning has been proven to increase the learning motivation of students who previously felt afraid and bored with many formulas. This application makes the learning process more enjoyable, interesting, and entertaining, thus triggering students' motivation to learn. By using the Wordwall application, all students are actively involved and very enthusiastic about learning. They even compete to solve problems in the application, sometimes feeling inadequate and addicted because of the excitement in solving those problems. The Wordwall application successfully creates a lively classroom atmosphere, making all students enthusiastic about learning.

One of the advantages of using the Wordwall application in this study is the variety of games provided in the application, which prevents students from feeling bored and instead increases their enthusiasm and activity in solving problems. They also show a high desire to understand the material learned both through discussions and independently. However, there are some challenges in this study, such as the possibility of errors in the Wordwall application and difficulties in internet signal, which slightly hinder the learning time. To overcome this problem, teachers can ensure that the internet network used is good and stable, for example, by using tethering hotspots if the wifi signal in the classroom is not adequate to use the Wordwall application in learning. In efforts to increase students' learning motivation, the role of teachers is very important. Teachers need to have creativity,

innovation, and technology skills to design and implement effective and engaging learning. This will help improve students' learning motivation as well as their learning outcomes and achievements.

However, it is important to note that the results of this research do not fully depict causality between the use of Wordwall media and the improvement of students' motivation in learning mathematics. Other factors such as teaching methods, learning environment, and student characteristics may also contribute to changes in student motivation. Therefore, further research with stricter designs and better variable controls may provide a deeper understanding of the effectiveness of using Wordwall media in enhancing students' learning motivation in mathematics.

2. Differences in Students' Motivation Levels Based on the ARCS Model in Mathematics Learning Utilizing Wordwall Media, Considering Sex Factors.

Based on Table 6, there are 199 female students and 184 male students out of a total of 216 respondents. The data classification of student learning motivation based on sex can be presented in Table 9.

Table 9. Classification of Learning Motivation Based on Sex.

Test	Score Interval	Classification	f		Percentage (%)	
			Male	Female	Male	Female
Pretest	851 – 1000	Very High	7	9	3,80	4,52
	601 – 850	High	42	58	22,83	29,15
	451 – 600	Medium	40	29	21,74	14,57
	301 – 450	Low	5	3	2,72	1,51
	200 – 300	Very Low	110	80	59,78	40,20
Total Subjects			184	199	184	199
Mean			The category is (Medium)	The category is (Medium)	469,82 (46,92%)	512,28 (51,23%)
Posttest	851 – 1000	Very High	17	14	9,24	7,04
	601 – 850	High	88	111	47,83	55,78
	451 – 600	Medium	77	61	41,85	30,65
	301 – 450	Low	8	7	4,35	3,52
	200 – 300	Very Low	-	-	-	-
Total Subjects			184	199	184	199
Mean			The category is (High)	The category is (High)	788,07 (78,81%)	848,75 (84,88%)

Based on Table 9, it can be concluded that there is a significant improvement in posttest scores compared to pretest scores in both sex groups, indicating an enhancement in understanding the material. In the pretest, the majority of students were in the low and very low score categories, but in the posttest, the majority of students moved to the high and very high score categories. This indicates that the instructional program has successfully improved students' understanding of the subject matter, especially in the male sex group.

Based on Table 9, it can be seen that out of a total of 216 respondents, there were 199 female students and 184 male students. Data on the classification of students' learning motivation by sex shows differences in the distribution of learning motivation scores between male and female students. In the pretest, the majority of male and female students had learning motivation scores in the low and very low categories, with the highest percentage in the very low category. The percentage of male students in the very low category reached 59.78%, while the percentage of female students was 40.20%. This indicates that before participating in the learning program, most students had low levels of

learning motivation. However, in the posttest, there was a significant increase in learning motivation scores in both sex groups. The majority of students, both male and female, have moved up to the high and very high score categories. The percentage of male students in the high and very high score categories reached 78.81%, while the percentage of female students was 84.88%. This indicates that the learning program has successfully increased students' learning motivation, especially in understanding the subject matter.

If we want to distinguish between males and females, the first thing to be examined is sex, which is the biological characteristic that distinguishes between males and females (Relawati, 2011). Biological differences between males and females, such as the X and Y chromosomes, can affect brain development and cognitive function. The X chromosome, which is dominant in females, is involved in higher-level brain functions and other factors related to intelligence. Therefore, women tend to have twice the high-level cognitive processing compared to men. These differences also create different preferences and behaviors in the learning environment. Girls prefer a structured environment, while boys prefer an unstructured environment. Some aspects of learning motivation, such as the desire to succeed, learning drive, future expectations, rewards, engaging learning activities, and conducive learning environments, are crucial in improving learning outcomes. Women, with the X chromosome associated with high-level cognitive processing, tend to have a better understanding of learning motivation indicators. These research findings are consistent with previous studies that have shown differences in abilities between males and females in some cognitive areas. Thus, learning motivation is an internal and external drive that encourages students to change their learning behavior. Motivation also plays a role in determining the direction, goals, and selection of appropriate actions to achieve learning goals. Therefore, learning motivation plays an important role in improving student learning outcomes. In conclusion, there was a significant increase in posttest scores compared to pretest scores in both sex groups. This indicates that the learning program has successfully improved students' understanding of the subject matter, as well as increased overall student learning motivation, especially in the male sex group.

3. Analyzing the Percentage of Each ARCS Aspect Contributing to the Level of Learning Motivation in Mathematics Education Utilizing the Wordwall Media.

Based on Table 4, there are 200 questions covering the four aspects of learning motivation, namely Attention, Relevance, Confidence, and Satisfaction. Students' motivation scores on each aspect of ARCS are represented in Table 10.

Table 10. Percentage of Student Learning Motivation Based on the ARCS Model.

Test	School Name	The Learning Motivation Indicator (%)			
		Attention	Relevance	Confidence	Satisfaction
Pretest	SMAN 1	48,36	48,29	47,19	53,70
	SMAN 2	51,89	51,35	40,94	57,28
	SMAN 3	50,74	49,48	48,97	55,53
	MAN 1	52,07	51,29	43,62	57,90
	MAN 2	51,96	50,62	45,19	60,18
	SMKN 1	52,67	51,16	42,20	58,44
	SMKN 2	47,96	46,56	40,47	56,48
The Mean Overall Pretest		50,81 (Moderate)	49,82 (Moderate)	44,81 (Moderate)	57,07 (Moderate)
Posttest	SMAN 1	72,38	74,11	74,93	73,89
	SMAN 2	77,67	78,81	78,11	78,82
	SMAN 3	75,94	75,93	73,18	76,41

Test	School Name	The Learning Motivation Indicator (%)			
		Attention	Relevance	Confidence	Satisfaction
	MAN 1	77,94	78,71	79,17	79,67
	MAN 2	77,77	77,68	76,29	82,81
	SMKN 1	78,83	78,52	76,67	80,42
	SMKN 2	71,78	71,45	73,84	77,72
The Mean Overall Posttest		76,04 (High)	76,46 (High)	76,03 (High)	78,53 (High)

Based on Table 10, it can be concluded that there was a significant increase in students' learning motivation from the pretest to the post-test in all schools examined. The average indicators of learning motivation in the posttest showed consistent improvement, with values indicating high classification for all learning motivation indicators based on the ARCS model, demonstrating the effectiveness of the intervention provided. This indicates that the intervention of mathematics learning aided by Wordwall media has a positive impact on improving students' learning motivation in various schools examined.

Analyzing the percentage contribution of each ARCS aspect to the level of learning motivation in mathematics learning using Wordwall media is an important part of evaluating the effectiveness of learning interventions. From Table 10, it can be seen that there are 200 questions covering the four aspects of learning motivation, namely Attention, Relevance, Confidence, and Satisfaction. Student motivation scores for each ARCS aspect are represented in the table. In the pretest, the average indicator of student learning motivation shows a moderate classification for all aspects of learning motivation based on the ARCS model. This indicates that before the intervention, student learning motivation tends to be at a stable level but has not yet reached an optimal level. However, after the intervention of mathematics learning using Wordwall media, there is a significant increase in student learning motivation from the pretest to the posttest in all schools examined.

This improvement is reflected in the average scores of learning motivation indicators on the posttest, which show a high classification for all aspects of learning motivation based on the ARCS model. The same trend also occurs in the aspects of Relevance, Confidence, and Satisfaction, all of which show consistent improvement from pretest to posttest.

1. Attention increased from an average pretest score of 50.81% to an average posttest score of 76.04%, in line with Fitriah's research (2018) that attention is crucial in students' learning motivation as it influences their ability to focus on learning materials. When students can pay sufficient attention to the lesson, they tend to be more engaged in the learning process and have a better chance of understanding the material.
2. Relevance also experienced an increase from an average pretest score of 49.82% to an average posttest score of 76.46% and is considered important because students tend to be more motivated to learn when they see the connection between the lesson material and their daily life or goals. This is consistent with the findings of Yulianto's research (2023) that when students realize the relevance of the material to their lives, they tend to feel more motivated to learn and are more likely to develop a greater interest in learning.
3. Confidence increased significantly from an average pretest score of 44.81% to an average posttest score of 76.03%. Based on Rahmah et al.'s research (2023), confidence is a key factor in students' learning motivation as it has a direct impact on their academic success. Confident students tend to be more willing to face challenges, more persistent in learning efforts, and better able to overcome obstacles that may arise in the learning process (Kaur & Prendergast, 2022).
4. Satisfaction also increased from an average pretest score of 57.07% to an average posttest score of 78.53%. Satisfaction plays a crucial role in students' learning motivation as it has

a direct impact on their overall learning experience (Yaniawati et al., 2020). When students are satisfied with their learning experience, they tend to be more motivated to continue learning and strive for better results in the future (Napitupulu, 2020).

These results affirm the effectiveness of Wordwall-assisted mathematics learning interventions in improving students' learning motivation in various schools studied. The use of the Wordwall application can serve as an interactive medium to assist teachers in explaining taught materials. This application can also enhance students' learning motivation and help them improve their learning outcomes (Afifa et al., 2023). The findings of this article are supported by research conducted by Nissa & Renoningtyas (2021). This research offers theoretical contributions by delving into the effectiveness of learning interventions within mathematics education. Through a detailed analysis of each aspect of the ARCS model and its contribution to learning motivation, the study provides valuable insights into the intricate dynamics of student motivation. By illuminating how various elements influence motivation levels, the research contributes to a deeper understanding of the factors shaping student engagement and motivation in mathematics learning, enriching the existing scholarly discourse on the subject (Kanda, 2020).

From a practical standpoint, the findings of this research hold significant implications for educators and practitioners in the field of mathematics education. The notable increase in student learning motivation after the intervention suggests that employing interactive tools like Wordwall media can effectively enhance motivation in mathematics learning. This highlights the potential for educators to integrate such technology into their teaching methodologies to stimulate student engagement and foster a more motivating learning environment. Furthermore, the study underscores the holistic impact of the intervention on various dimensions of learning motivation, including Attention, Relevance, Confidence, and Satisfaction. This underscores the importance of addressing multiple facets of motivation in educational interventions to achieve optimal results. Educators can leverage these insights to design comprehensive interventions that cater to diverse motivational needs, thereby maximizing their effectiveness in promoting student engagement and motivation. Lastly, the research underscores the pivotal role of relevance in nurturing motivation, emphasizing the importance of connecting lesson material to students' daily lives and goals. By incorporating real-world examples and applications into their teaching, educators can enhance students' motivation and foster greater engagement. Additionally, prioritizing students' confidence and satisfaction with the learning process can create a supportive and conducive environment that sustains motivation and promotes positive learning outcomes (Putra et al., 2018).

4. Percentage of Learning Motivation in Each ARCS Aspect in Mathematics Learning Utilizing Wordwall Media Considering Sex Differences.

Each aspect of ARCS motivation shows differences in outcomes based on sex. The percentage of each aspect of ARCS motivation based on sex can be seen in Table 11.

Table 11. Percentage of Student Learning Motivation Based on ARCS Model by Sex

Sex	Test	School Name	The Learning Motivation Indicator (%)			
			Attention	Relevance	Confidence	Satisfaction
Male	Pretest	SMAN 1	45,07	45,01	43,98	50,05
		SMAN 2	48,37	47,87	38,16	53,39
		SMAN 3	47,29	46,12	45,64	51,76
		MAN 1	48,54	47,81	40,65	53,97

Sex	Test	School Name	The Learning Motivation Indicator (%)			
			Attention	Relevance	Confidence	Satisfaction
		MAN 2	48,43	47,18	42,12	56,09
		SMKN 1	49,09	47,69	39,33	54,47
		SMKN 2	44,70	43,40	42,46	52,64
	The Mean Overall Pretest		47,36 (Moderate)	46,44 (Moderate)	41,77 (Moderate)	53,20 (Moderate)
	Posttest	SMAN 1	71,39	71,29	69,66	79,27
		SMAN 2	76,61	75,81	60,44	84,56
		SMAN 3	74,90	73,04	72,29	81,97
		MAN 1	76,87	75,71	64,39	85,47
		MAN 2	76,70	74,72	66,70	88,84
		SMKN 1	77,75	75,53	62,30	86,27
		SMKN 2	70,80	68,73	67,25	83,38
	The Mean Overall Posttest		75,00 (High)	73,55 (High)	66,15 (High)	84,25 (High)
Female	Pretest	SMAN 1	51,64	51,56	50,39	57,34
		SMAN 2	55,41	54,83	43,72	61,16
		SMAN 3	54,18	52,83	52,29	59,29
		MAN 1	55,60	54,76	46,57	61,82
		MAN 2	55,48	54,05	48,25	64,26
		SMKN 1	56,24	54,63	45,06	62,40
		SMKN 2	51,21	49,71	48,64	60,31
	The Mean Overall Pretest		54,25 (Moderate)	53,20 (Moderate)	47,85 (Moderate)	60,94 (Moderate)
	Posttest	SMAN 1	79,15	79,04	77,24	87,89
		SMAN 2	84,94	84,06	67,02	93,76
		SMAN 3	83,05	80,98	80,15	90,89
		MAN 1	85,23	83,95	71,39	94,77
		MAN 2	85,05	82,85	73,96	98,50
		SMKN 1	86,21	83,75	69,07	95,66
		SMKN 2	78,50	76,21	74,56	92,45
	The Mean Overall Posttest		83,16 (High)	81,55 (High)	73,34 (High)	93,42 (Very High)

Based on Table 11, it can be concluded that students' learning motivation in the Attention, Relevance, and Confidence indicators experienced a significant increase in the posttest compared to the pretest, both for male and female students. Overall, the average learning motivation of students in the posttest shows a high category for all indicators, indicating a significant improvement in students' learning motivation after participating in mathematics learning assisted by Wordwall media. Additionally, there is a significant difference between the learning motivation of male and female students, with the average learning motivation of female students tending to be higher than male students both in the pretest and posttest. This indicates the need for more specific learning strategies to support student learning motivation, especially regarding Confidence, which shows a low category in the pretest.

Based on Table 11, the percentage of students' mathematics learning motivation based on the ARCS model and sex, there are interesting differences in the responses of male and female students to mathematics learning using Wordwall media. In terms of attention, relevance, confidence, and satisfaction aspects, both show significant improvements from pretest to posttest. Male students show an increase from 47.36% to 75.00% in the attention aspect, while female students experience an increase from 54.25% to 83.16%. Similarly, in the relevance aspect, where male students increase from 46.44% to 73.55%, while female

students increase from 53.20% to 81.55%. Furthermore, in the confidence aspect, both groups showed significant improvements, with the percentage of males rising from 41.77% to 66.15%, and females rising from 47.85% to 73.34%. Likewise, in the satisfaction aspect, male students increase from 53.20% to 84.25%, and female students increase from 60.94% to 93.42%. Although there are differences in the percentage of learning motivation between the two sexs, the positive effect of using Wordwall media in increasing learning motivation is evident in both groups.

Sex, as a biological characteristic that distinguishes between males and females, has a significant impact on students' learning preferences and behaviors (Nur & Palobo, 2018). Humans have 23 chromosomes from the mother's egg and 23 chromosomes from the father's sperm, two of which are present in different forms called the X chromosome and the Y chromosome. An egg combined with two X chromosomes develops into a female, while an egg combined with an X and a Y chromosome develops into a male. The X chromosome, in particular, contains many genes that regulate brain functions such as high-level cognitive processing, which influences differences in learning preferences and skills between males and females. These differences affect students' preferences and comfort in learning environments. Girls tend to be more comfortable in structured environments that operate on a schedule and use verbal instructions, while boys prefer unstructured environments and rely more on visual skills in learning. Differences in learning preferences reflect differences in cognitive processing between the two sexs (Setyowati et al., 2022).

The research highlights several key theoretical contributions and practical implications regarding the impact of sex differences on learning motivation in mathematics, particularly when using Wordwall media. Theoretically, the study validates the effectiveness of the ARCS (Attention, Relevance, Confidence, Satisfaction) model in measuring and enhancing learning motivation among students. Both male and female students show significant improvements across all aspects of the ARCS model, confirming its robustness and applicability in diverse educational settings. Furthermore, the research provides empirical evidence on how sex differences influence learning motivation in mathematics. Female students show higher percentages in all ARCS aspects compared to male students, supporting the theory that sex impacts cognitive processing and learning preferences. This aligns with existing literature suggesting that females tend to have higher cognitive abilities related to learning motivation indicators. Additionally, the study reinforces the theoretical understanding that genetic and biological differences, such as the presence of the X chromosome, contribute to variations in cognitive processing between sexs. This, in turn, affects learning preferences and behaviors, with females generally showing a higher ability to interpret and respond to learning motivation indicators.

Practically, educators can use these findings to design more effective teaching strategies that cater to the different motivational needs of male and female students. For instance, integrating more verbal and structured activities might benefit female students, while incorporating visual and unstructured elements could better engage male students. The positive impact of Wordwall media on learning motivation suggests that interactive and gamified learning tools can significantly enhance students' engagement and performance in mathematics. Schools and educators should consider incorporating such tools into their curriculum to foster a more stimulating learning environment. Additionally, understanding that sex influences learning motivation and preferences underscores the importance of sex-sensitive pedagogy. Teachers should be aware of these differences and strive to create inclusive classroom practices that support both male and female students' learning needs. Insights from the study can inform professional development programs for teachers, helping

them to recognize and address sex-specific learning needs and motivational factors in their teaching practices. In conclusion, the research demonstrates that while sex differences do significantly influence learning motivation, the use of interactive learning media like Wordwall can effectively boost motivation for both sexs. By acknowledging these differences and applying tailored strategies, educators can enhance the overall learning experience and outcomes for their students. This study not only contributes to the theoretical understanding of sex and learning motivation but also offers practical solutions to improve educational practices.

Research also indicates that females tend to have higher cognition than males because the X chromosome is associated with high-level cognitive processing. This makes females better able to interpret indicators of learning motivation compared to males (Trisnawati et al., 2023). Other studies also support this finding, showing that females excel in tests of comprehension speed, fluency in speaking, and certain manual tasks. In the context of learning motivation, sex also plays a significant role. Learning motivation, as both internal and external drive in students, is closely related to students' preferences, goals, and cognition. Sex, as a biological characteristic, significantly impacts students' learning preferences and behaviors (Nur & Palobo, 2018). Previous research indicates that females tend to have higher cognition levels than males due to the X chromosome, which is associated with high-level cognitive processing. This makes females better able to interpret indicators of learning motivation compared to males (Trisnawati et al., 2023). Other studies also support this finding, showing that females excel in comprehension speed, fluency in speaking, and certain manual tasks. In line with these findings, your research also shows that female students demonstrate higher increases in learning motivation across all ARCS aspects compared to male students. Previous studies have found that girls are more comfortable in structured environments that operate on a schedule and use verbal instructions, while boys prefer unstructured environments and rely more on visual skills in learning (Setyowati et al., 2022). Your findings align with this, showing that the use of Wordwall media, which can be structured or unstructured, positively affects both sexs, with female students showing slightly higher motivation gains.

Learning motivation, as both an internal and external drive, is closely related to students' preferences, goals, and cognition (Septiyan & Pujiastuti, 2019). Students motivated internally and externally tend to achieve optimal learning outcomes. Your study confirms this by showing that the interactive and engaging nature of Wordwall media enhances both internal and external motivation among students, leading to significant improvements in learning motivation. This research findings corroborate previous studies on sex differences in learning motivation and the impact of teaching methods. The use of Wordwall media shows a clear positive effect on students' learning motivation, with female students generally showing higher motivation increases. This suggests that interactive and engaging teaching tools like Wordwall can effectively enhance learning motivation for both sexs, though females might respond slightly better to these tools. Understanding these differences can help educators design more effective and supportive learning strategies tailored to both sexs. Students who are motivated internally and externally tend to achieve optimal learning outcomes because motivation drives them to act, determine the direction of their actions, and select actions that align with their goals (Septiyan & Pujiastuti, 2019). Thus, understanding the differences in learning motivation between males and females can help educators design more effective and supportive learning strategies for both sexs.

5. The Influence of Wordwall-Based Mathematics Learning by Sex as Seen from the ARCS Model of Motivation.

Before hypothesis testing is conducted by analyzing paired sample t-tests on students' mathematical reasoning outcomes, prerequisite tests need to be performed including normality test (Kolmogorov-Smirnov test) and homogeneity test (Levene's test) in each group.

Table 12. Normality and Homogeneity Tests

		Kolomogrov-smirnov[a]			Levene
	Sex	Statistic	df	Sig.	Statistic
The Results of Mathematics Learning Motivation	Pretest_Male	.146	183	.102	.767
	Posttest_Male	.140	183	.140	
	Pretest_Female	.153	198	.069	
	Posttest_Female	.138	198	.148	

The results from the normality test showed sig values greater than 0.05, namely Kolmogorov-Smirnov 0.102 and 0.140 for the pretest or posttest of male students, and 0.069 or 0.148 for the pretest and posttest of female students. Therefore, it can be concluded that the data on the motivation scores of male and female students in mathematics are normally distributed. Meanwhile, the data obtained from the homogeneity test showed significance values greater than 0.05 (5%), which is 0.767. Hence, the data is considered homogeneous. Furthermore, in the paired sample t-test conducted to examine the differences in pretest and posttest results based on sex, the results of hypothesis testing for pretest and posttest can be seen in Table 13 below.

Table 13. Results of Paired Sample t-Test

		Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-taild)
Pair 1	Pretest-Postest Male	-48.167	12.251	1.506	-31.975	183	.000
Pair 2	Pretest-Postest Female	-44.833	9.868	1.802	-24.884	198	.000

Based on Pair 13 output, the sig. value (2-tailed) is 0.000 < 0.05, therefore it can be concluded that there is a difference in the average mathematics learning motivation scores of male students between pretest and posttest in mathematics learning using Wordwall media. Furthermore, based on the output results in Pair 2, the sig. value (2-tailed) is 0.000 < 0.05, thus it can be concluded that there is a difference in the average mathematics learning motivation scores of female students between pretest and posttest in mathematics learning using Wordwall media. Thus, it can be concluded that there is an influence of Wordwall-based mathematics learning based on sex as seen from the ARCS motivation model.

This study aims to evaluate the impact of Wordwall-based mathematics learning on student motivation, considering sex differences and utilizing the ARCS Model (Attention, Relevance, Confidence, Satisfaction) as the research framework. Firstly, the attention aspect in mathematics learning is represented by Wordwall's ability to capture students' attention. According to Smith and Dillon (2019), the use of interactive media like Wordwall can enhance students' attention to mathematical learning materials. Furthermore, the relevance of mathematics learning with Wordwall media is reflected in its ability to make mathematical concepts more relevant to students' daily lives. Johnson and Johnson (2020) indicate that the use of media relevant to everyday life can increase students' interest in mathematics learning. Additionally, students' confidence in understanding and mastering mathematical concepts can be enhanced through learning with Wordwall media. Chen et al. (2021) found that the use of media that reinforces problem-solving skills and provides immediate feedback can increase students' confidence in mathematics learning. Finally, students' satisfaction with mathematics learning can also be enhanced through the enjoyable and interactive use of

Wordwall media. Wang and Shih (2018) show that students tend to be more satisfied with learning involving interactive media and opportunities for active participation in the learning process. Thus, it can be concluded that Wordwall-based mathematics learning has a positive influence on student motivation in terms of attention, relevance, confidence, and satisfaction, as evidenced by empirical findings from previous studies.

This study provides several significant theoretical contributions and practical implications in the context of mathematics education. Theoretically, this research integrates the ARCS Model (Attention, Relevance, Confidence, Satisfaction) into the context of mathematics learning using interactive media like Wordwall. It demonstrates how each component of the ARCS model can be effectively employed to enhance student motivation. Additionally, this study offers empirical evidence supporting the effectiveness of interactive media in educational settings. By showing how Wordwall media affects students' attention, relevance, confidence, and satisfaction in learning mathematics, this research strengthens the theoretical framework that considers media as a crucial tool in modern education. The study also explores sex differences in learning motivation, contributing to the theoretical discourse on how socio-psychological factors like sex influence educational outcomes. This helps in understanding the nuanced ways male and female students respond to different educational interventions.

Practically, the findings of this research can be utilized by educators to design more effective teaching strategies. By integrating engaging and interactive media like Wordwall, teachers can capture and sustain students' attention, and make mathematical concepts more relevant and interesting, thus improving overall learning outcomes. Understanding that sex differences affect learning motivation allows educators to tailor their teaching methods to better meet the needs of both male and female students. For instance, incorporating competitive elements may be more engaging for male students, while real-life applications might better motivate female students. Curriculum developers can integrate interactive media and the principles of the ARCS model into the mathematics curriculum to create a more motivating and engaging learning environment. This can enhance student satisfaction and academic achievement in mathematics. Teacher training programs can also include training on the use of interactive media like Wordwall and the application of the ARCS model, improving teachers' ability to create motivating and effective learning experiences for their students. The study also examines whether learning motivation, influenced by sex differences, affects the effectiveness of Wordwall media in enhancing mathematics performance. Previous research indicates that male and female students may respond differently to various aspects of the ARCS model. Interactive media like Wordwall can capture the attention of both sexs, but the type of interactive elements may need to be adjusted to maximize engagement. Male students might prefer competitive or gamified elements, while female students might be more responsive to collaborative and contextually relevant activities.

Making mathematics relevant to everyday life can boost motivation for female students, who often value practical applications. Customizing Wordwall activities to reflect real-life scenarios might be particularly effective for them. Immediate feedback and reinforcement of problem-solving skills provided by Wordwall can boost the confidence of both sexs. However, the approach to providing feedback might need to be tailored based on specific sex preferences to optimize confidence building. Enjoyable and interactive learning experiences are likely to enhance overall satisfaction. Ensuring that Wordwall activities are inclusive and cater to diverse interests can help maintain high levels of student satisfaction. The findings of this study indicate that Wordwall-based mathematics learning, informed by

the ARCS model, has a positive impact on student motivation. Sex differences play a significant role in how these motivational aspects are experienced, highlighting the need for tailored educational strategies. The theoretical contributions and practical implications of this research provide valuable insights for educators, curriculum developers, and policymakers aiming to improve mathematics education through interactive media and motivational frameworks.

CONCLUSION

Based on the research findings, the majority of students exhibit high levels of learning motivation, with 78.81% of 184 male students and 84.88% of 199 female students showing high motivation. The main conclusions of this study are as follows: Female students tend to have higher motivation in learning mathematics compared to male students. Female students' motivation is higher in every aspect of the ARCS motivation model (Attention, Relevance, Confidence, Satisfaction). The Satisfaction aspect received the highest percentage, at 78.53%. Both male and female students experienced significant improvements in motivation from pretest to posttest. There is a significant effect before and after Wordwall-based mathematics learning observed from the ARCS model in terms of gender. The practical implications are that educators can develop targeted interventions to address the specific motivational needs of male and female students. Using interactive and gamified learning tools like Wordwall can enhance students' motivation and learning outcomes. The high percentage in the Satisfaction aspect indicates that students respond well to activities that provide a sense of achievement and enjoyment. This research has several limitations, such as a limited sample size and a research design that does not control for external variables. Further research with more robust experimental designs and diverse samples is needed to validate these findings. Overall, while this study provides valuable insights into gender differences in mathematics learning motivation and the effectiveness of Wordwall-based interventions, further research with more rigorous methodologies and diverse samples is necessary to broaden the understanding of mathematics learning motivation. These findings can inform educational practices and policies aimed at enhancing student motivation and improving learning outcomes.

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