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Research Article
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Effect of ARCS (Attention, Relevance, Confidence, and Satisfaction) Model on Academic Achievement of 9th-Grade Biology Students

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Abstract: *This study was conducted to investigate the effect of the ARCS (Attention, Relevance, Confidence, and Satisfaction) Model on the academic achievement of 9th-grade biology students in District Swabi. The objectives of the study were: to investigate the effect of the ARCS (Attention, Relevance, Confidence, and Satisfaction) model on the academic achievement of secondary school students and to compare the effect of the ARCS model and lecture method on the academic achievement of the students in the subject of Biology. This study was a true experimental, and the pretest-posttest control group design was employed in this study. All the students of the 9th grade (148) at Government High School, Lahor (Swabi) constituted the population of this study. Random sampling technique through matching pairs was used to select 60 students of the 9th grade as a sample for the study. The pre-test consisted of a research instrument, i.e., the Subject Achievement Test. The experimental group was instructed through the ARCS model, and the control group was instructed through the lecture method. Eight lesson plans were developed, covering all four components of the ARCS model. Descriptive analysis was used to calculate the Mean and Standard Deviation. A t-test was applied. SPSS (25) was used for the whole data analysis. This study highlights the use of the ARCS Model; the experimental group did much better in school, as shown by significant increases in post-test scores, high positive correlations, and large t-test findings. The control group, on the other hand, only showed a small improvement in post-test scores with a weak association and less noticeable gains. Overall, the findings strongly support the idea that the ARCS Model is better than the lecture-based approach to helping 9th-grade students do better in school and keep doing better.*

Key Words: Academic Achievement, Educational Resources, Learners' Enthusiasm, 9th-Grade

Introduction

For many years, there have been many techniques to educate and learn, and they have been enhanced, changed, and made better over time. Every instance and adjustments are carefully planned, taking into account what the learners can do, what they need, and what they like. It is important to look at students' motivation and desire to learn as important parts of good education, in addition to the different ways that have been used to improve instructional methods. Students require supplementary resources and support to aid them during the learning process; therefore, understanding what motivates them to take charge of their education is crucial. Both young learners and adults engaged in language acquisition require help through various forms of motivating influence. Driven by intrinsic or extrinsic causes, learners are observed to manage their education in all situations. Recognising that each student possesses distinct and exceptional qualities, their approach to and management of the learning process may also differ. Consequently, the educational content and materials must be innovatively designed to cater to the interests of these learners. The incorporation of certain motivational elements would enhance learning and foster learners' enthusiasm for education (Faruk et al., 2022).

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To be more specific, secondary school students study the three main fields of pure science: Biology, Chemistry, and Physics (Aina & Ayodele, 2018; Akintola & Ahmed, 2018). According to Alkhawaldeh et al. (2023), "These disciplines aid students in getting ready for courses focused on pure science and science at the postsecondary level as well as for their future careers". The pedagogical approach is a contributing factor to the diminished interest in science, underscoring the necessity for alternative teaching strategies that could stimulate student engagement and improve academic performance (Ajaja, 2013). Science educators encountered challenges in effectively conveying concepts to enhance students' knowledge and engagement. The concern regarding the performance of learners in biology has resulted in numerous ideas for improvement. Regrettably, these ideas center on inappropriate teaching methodologies and inadequate real-world experiences as the primary factors contributing to students' subpar performance in biology. A significant number of students encountered challenges in comprehending biological concepts (Castro & Morales, 2017; Mead et al., 2017).

"Academic achievement is an important component of the system, one of its main purposes, and one of its outcomes since it affects the development and evaluation of the school environment and stimulates the interest of teachers, students, and parents. It is among the most crucial requirements for a student to advance from one educational level to the next" (Al-Bardini, 2020). The achievement of students is an important part of the educational process and is consistent with it at all stages. Teachers evaluate students based on their test performance, emphasizing the need to assess and monitor academic achievement by representing the teacher's effective employment. Academic achievement is the total of a student's academic improvements in one or more program courses, which help the student become more used to the classroom and identify the barriers inhibiting him from achieving (Harahap, 2019). Exams are used to gauge a student's progress in academic courses and assist them in acquiring a particular level of competency that will enable them to address difficulties in their everyday life concerning the curriculum and its goals. The performance of the student in academic courses is measured by the test scores after the semester or year, which represents the student's cognitive outcome.

The Attention, Relevance, Confidence, and Satisfaction model emerged as a viable option. According to Sulistyawan (2017)," The Attention Relevance Confidence and Satisfaction model is a set of learning activities that begin with steps that grab students' attention, establish a connection between what they are learning and their needs and goals (relevance), boost their confidence (confidence), and make them feel satisfied when their learning objectives are met (satisfaction), all in the hopes of creating a meaningful learning environment". Students benefit from an effective learning process, claim Winaya et al. (2013). The learner can sense that his teacher is paying attention to him through feedback. According to Zulfa et al. (2021), "Teachers mostly teach the content to complete quickly without considering the students' learning and rarely provide feedback following a theme assessment. Immediate feedback is one kind of feedback. Simply said, feedback is the result of direct or indirect exchange interactions between teachers and learners. Students should get reverse knowledge as quickly as possible, as this allows for the quick correction of incorrect information through the subsequent learning exercise". While the ARCS model has been examined and implemented in a variety of educational contexts around the world, its particular implementation and effectiveness in Pakistan's secondary schools may have gone neglected. Performing research in this area can help to close a research gap and broaden the knowledge based on successful teaching methods for enhancing academic achievement and motivation in Pakistan. This study offers valuable insights and recommendations for educators, policymakers, and stakeholders aimed at enhancing educational quality, fostering student engagement, and ultimately elevating the overall educational standard in the country.

Objectives of the Study

- To investigate the effect of the ARCS (Attention, Relevance, Confidence and Satisfaction) model on the academic achievement of secondary school students.
- To compare the effect of the ARCS model and the lecture method on the academic achievement of the students in the subject of Biology.

Literature Review

The effectiveness, diversity, and relevance of the ARCS concept have resulted in its implementation in diverse contexts across multiple countries. The ARCS model has been demonstrated by various researchers (Huang et al., 2004; Lin, 2008) to enhance student motivation. It offers a systematic approach to motivational design that can be easily adapted to diverse educational settings, including traditional instruction, distance learning, internet-based education, computer-assisted instruction, macroeconomics, and table tennis (Carpenter, 2011; Chiu-Ju et al., 2007; Margueratt, 2007; Naime-Diefenbach, 1991; Suzuki & Keller, 1996; Visser et al., 2002). A multitude of investigations employed the paradigm comprehensively, encompassing all categories and adhering to each phase.

Keller's educational-motivational model (Goksu & Bolat, 2021) can help you improve your academic achievement. The strategy is grounded in expectation values and seeks to motivate students to engage in further study. It should also be utilized for program development and planning (Wu, 2018). Keller's ARCS model integrates theories and motivational strategies with instructional design to formulate an effective approach that enhances student enjoyment and encourages mastery of the four components or strategies encompassing interaction, credibility, and focus (Li & Keller, 2018). According to his learning strategy, "Motivational design which is the process of organizing materials and guidelines to alter people's motivation as well as tactics, ideas, and procedures that are employed to make learning appealing to students occurs in conjunction with systematic educational design rather than in isolation from other elements that influence learning" (Simsek, 2014). These four elements can be described as: "The attention strategy, which stimulates and sustains curiosity and attention; the communication strategy, which is concerned with the needs, interests, and motivations of the learners; the confidence strategy, which aids students in creating positive expectations and making successful progress; and the satisfaction strategy, which offers both internal and external reinforcements for dedication and activity" (Daugherty, 2019). The first step in the educational-motivational model is to scrutinize the student's motivation and figure out what hinders them from being motivated. Subsequently, in the formulation of instructional strategies, innovative concepts are generated, compelling plans are documented, and the optimal plan is selected (Luo et al., 2022).

Turel and Ozer (2018) discovered that the implementation of digital learning materials grounded in Keller's model enhances academic performance and motivation, evidenced by a significant disparity of 1100.487 regarding the experimental and control groups ($p<.01$). Conversely, Khan et al. (2019) reported that students' learning motivation escalated following the utilization of augmented reality mobile applications, with attention, confidence, and satisfaction increasing by percentage variations, while the relevance factor diminished, aligning with the favorable results associated with the ARCS motivational model. Hsu (2020) demonstrated in his quasi-experimental study that learning motivation using virtual reality enhanced all components by 7.30, with increases of 0.25 in "Attention," 0.16 in "Relevance," 0.16 in "Confidence," and 0.34 in "Satisfaction." The use of interactive multimedia learning can greatly increase students' motivation for academic achievement (Herianto & Wilujeng, 2021). Specifically, students' attention was augmented by 10.83%, their confidence elevated by 13.60%, and their satisfaction enhanced by 9.54%. Nonetheless, the relevant aspect of motivation for learners to acquire knowledge did not experience a large boost, rising by about 1.45%.

Researchers and language practitioners consider the 'Attention' component in instructional materials for languages to be a vital motivational feature, as it sustains students' engagement throughout their studies (Lumbantobing & Haryanto, 2019). When kids can concentrate, they may also grasp the subject more rapidly. A multitude of individuals have seen the efficacy of media and its accessibility for education resulting from the integration of information and communication technology (ICT). Based on Wu's (2018) study on technological intervention, mobile-based learning effectively captures learners' attention by engaging their interest in the subject matter. "When properly designed and developed, educational resources can be engaging and tailored to the interests of students. In contrast to learning through traditional printed materials, computer technology allows for infinite attention. Content producers are provided with big opportunities and amazing ideas regarding creating content and resources which are relevant to the learners' features, expertise, and social background" (Wu, 2018). For instance, to help students become more attentive, "Attention" components like visuals, visual components, pictures, colors, noises, and so on might be incorporated. Hao and Lee (2019) found that respondents in the

experimental group exhibited superior performance in the attention dimension when compared with the control group; mobile learning exposed participants to components of media.

It is crucial to disclose the relevance of each learner's curriculum, including their learning objectives, requirements, and expectations (Giasiranis & Sofos, 2020). Students can easily anticipate their learning objectives, which aids in their ongoing education. This may occur if the learning objectives are stated clearly and concisely. Additionally, with the new learning, students should be presented with their preexisting schemata. This endeavor may also aid in demonstrating the relevance of the lesson to them. Recognizing that new knowledge is only an augmentation of their existing understanding, learners will possess the courage to pursue new courses and challenges when they can establish a relationship between their prior and current learning. In addition to motivating students, this learning phase may help them see how their knowledge is relevant. As learners appreciate their educational pursuits and experience satisfaction when they can utilize their acquired knowledge to develop novel abilities, it is advisable to incorporate this motivating element into the content creation process.

Although confidence is a crucial component of education, its importance and method are hardly teachable. It concerns how students relate to the learning and how they embrace the learning environment. Additionally, students must learn to believe in their abilities and potential. In this method, students can discover their unique learning path and develop self-confidence in their ability to handle it. It is possible to overcome the obstacles or the unfavorable perception of their learning deficit. As a result, students' self-belief to boost their confidence is a positive learning support system that helps them learn more (Dullien, 2016). Therefore, to increase learners' confidence, language instructors or content developers must utilize every piece of equipment and instrument available to them to add motivational learning components. This is made feasible by the growth of computer technology. This must be done throughout the learners' first learning phase, such as the introduction phase, and the confidence components must be integrated throughout the entire learning process. It's crucial to keep an eye on students' development during their learning activities to track their confidence. If educational resources and input do not engage learners, demonstrate the advantages of learning, or augment their previous knowledge, learners may discontinue their studies and efforts at any moment.

Every learner should be satisfied both throughout and after their educational journey (Hao & Lee, 2019). Satisfaction may be attained when learners can increase their knowledge, when the effort and time invested in learning is not lost, or when the material is worthwhile to investigate because it is simple and practical. It is intended that these experiences would help learners pay attention and retain information longer, as well as help the material be retained in their cognitive memory for a longer period. Therefore, when creating learning materials, characteristics that affect students' satisfaction must be considered. Every learning process could incorporate elements like feeling rewarded, benefiting, receiving encouragement and guidance, and feeling honored. After receiving enough practice, learners will experience rewards when they can achieve a greater comprehension of the subject. When students can anticipate the positive outcomes of their learning endeavors, they will also value education. It might result from the provided, unambiguous learning objectives. Rather, as they get feedback while studying, they will cherish the experience. When students can rectify incorrect interpretations and enhance their comprehension, this is a crucial piece of support. Lastly, when learning has aspects like interactive and infographics that encourage students to get interested and even revisit the teachings, they will undoubtedly feel honored and satisfied with their education (Hao & Lee, 2019).

Methodology

This study employed a true experimental, pre-test, and post-test framework, along with a control group. The Control and Experimental groups were allocated according to the scores obtained by students in the pre-test for 9th-grade Biology, as published by the Khyber Pakhtunkhwa Textbook Board, Peshawar (2024). The experimental group received instruction through the ARCS Model, whereas the control group was instructed using the Traditional Lecture Method. After the experimental phase, both groups received a post-test and a retention assessment. All students enrolled in the 9th grade at Government High School, Lahor (Swabi), were the study's target population. For this study, a random sampling method using matched pairs was applied to a total of 60 students of the 9th grade taking Biology at the Government

High School Lahor (Swabi). The students were divided into two equal groups, an experimental group and a control group, based on their pre-test scores. Each group consisted of 30 students, with one designated as the control group and the other as the experimental group. The four chapters of 9th-grade Biology were selected: Chapter 4: Cells and Tissues, Chapter 5: Cell Cycle, Chapter 6: Enzymes, and Chapter 7: Bio-Energetics. The researcher developed eight lesson plans for the experimental group, employing the ARCS model. Each lesson plan spanned one week (6 days). The lesson planning included four chapters, which were subdivided into eight weeks. The lesson plans for the experimental groups of the ARCS model were designed using a four-step method; each of these four steps has three additional tactics that were part of the ARCS model. The same subtopics were selected for the teaching control group also. The researcher implemented the ARCS model during instructional sessions for the experimental group, whereas the control group received instruction through the conventional lecture method, which is common practice in government high schools of Khyber Pakhtunkhwa.

Instrument

The researcher used the Subject Achievement Test (SAT) to gauge biology students' academic achievement. The chosen four SAT units contained forty multiple-choice questions, totalling forty marks. The research tool was utilized for the experimental and control groups' pre-test and post-test assessments. The researcher applied the international standard for marking multiple-choice questions. According to that, one mark is allocated to each correct multiple-choice question of the test. To maintain the standard errors, such as cutting, overwriting, erasing and picking of more than one option, were not allocated any marks. All the multiple-choice questions of the test were marked by the researcher according to the developed marking keys.

Data Analysis

Table 1

Group Statistics for Pre-test

Groups	*n*	*M*	*SD*	*SEM*
Experimental	30	11.57	2.23	.40
Control	30	11.00	2.31	.42

M: Mean, SD: Standard Deviation, SEM: Standard Error Mean

Table 1 shows that the mean score for the control group was 11.0, while the mean score for the experimental group was 11.57. The control group's standard deviation was 2.31, while the experimental group's was 2.23. The mean scores of the two groups were not significantly different from each other.

Table 2

Paired Samples Statistics for Experimental Group

	n	*M*	*SD*	*SEM*
Pre-test	30	11.57	2.23	.40
Post-test	30	29.70	2.05	.37

Table 2 shows that the mean score on the pre-test was 11.57, and it increased to 29.70 on the post-test. The standard deviation was 2.23 before the intervention, but it decreased somewhat to 2.05. A mean score increase of 18.13 signifies a substantial improvement in academic achievement, illustrating the positive impact of the ARCS model on student achievement.

Table 3

Paired Samples Correlation for Experimental Group

	N	*r*	*Sig.*
Pre-test & Post-test	30	.36	.86

As shown in Table 3, the experimental group's pre-test and post-test scores were positively correlated, as indicated by the correlation coefficient of 0.36. This suggests that the students' academic achievement

increased between the pre-test and post-test.

Table 4
Comparison t-test for the Experimental Group

		Paired Differences					t	df	Sig. (2-tailed)
		M	SD	SEM	95% CI				
					LL	UL			
Pair 1	Pre-test & Post-test	-18.13	2.41	.44	-19.03	-17.23	-41.08	29	.001

M: Mean, SD: Standard Deviation, SEM: Standard Error Mean, CI: Confidence Interval, LL: Lower Limit, UL: Upper Limit

Table 4 indicates a standard deviation of 2.41 and a t-value of -41.08. A mean score difference of -18.13 signifies a substantial difference between the pre-test and post-test outcomes. The p-value ($p < 0.05$) implies that this difference is statistically significant.

Table 5
Paired Samples Statistics for the Control Group

	n	M	SD	SEM
Pre-test	30	11.00	2.31	.40
Post-test	30	15.20	2.72	.39

As shown in Table 5, before and after the intervention, 30 students in the control group underwent assessments. The mean score increased from 11.00 to 15.20 during the pre-test and post-test. Before the intervention, the standard deviation was 2.31; following the intervention, it was 2.72. According to the data, students' academic achievement has improved somewhat over time. The control group was instructed through the conventional lecture method.

Table 6
Paired Samples Correlation for the Control Group

	N	R	Sig.
Pre-test & Post-test	30	-0.11	.95

Table 6 illustrates a weak negative correlation between the pre-test and post-test scores, evidenced by a correlation coefficient of -0.11. Students' academic achievement may have somewhat declined between the pre-test and post-test.

Table 7
Comparison t-test for the Control Group

		Paired Differences					t	df	Sig. (2-tailed)
		M	SD	SEM	95% CI				
					LL	UL			
Pair 1	Pre-test & Post-test	-4.20	3.59	.65	-5.54	-2.85	-6.39	29	.001

As shown in Table 7, the mean scores of the pre-test and post-test for the control group showed a difference of -4.20. The standard deviation was 3.59, and the t-value was -6.39. There was a significant difference in performance between the pre-and post-tests, as shown by a significance level lower than 0.05.

Table 8
Group Statistics for Post-test

Groups	n	M	SD	SEM
Experimental	30	29.70	2.05	.37
Control	30	15.20	2.72	.49

Table 8 shows that the control group's mean score was 15.20, whereas the experimental group's mean score was 29.70. The experimental group had a standard deviation of 2.05, while the control group had a standard deviation of 2.72. The two groups' mean scores show that they performed very differently.

Table 9

Paired Samples Statistics for Experimental Group

	n	*M*	*SD*	*SEM*
Post-test	30	29.70	2.05	.37
Retention test	30	27.63	2.02	.37

Table 9 shows that 30 students from the experimental group were tested for retention one month after the post-test. The mean score on the post-test was 29.70, and the average score on the retention test was 27.63. The post-test had a standard deviation of 2.05, while the retention test had a standard deviation of 2.02. The data show that there was no substantial difference in the way students did the pre-and post-tests.

Table 10

Paired Samples Correlation for Experimental Group

	n	*R*	*Sig.*
Post-test & Retention test	30	.57	.001

Table 10 shows that the correlation coefficient involving the post-test and retention test scores was 0.57, suggesting that there was a slightly encouraging association. This means that the scores of learners got slightly better between the post-test and the retention test, but not significantly.

Table 11

Comparison t-test for the Experimental Group

		Paired Differences					*t*	*df*	*Sig. (2-tailed)*
		M	*SD*	*SEM*	95% CI *LL*	95% CI *UL*			
Pair 1	Post-test & Retention test	2.06	1.87	.34	1.36	2.76	6.04	29	.001

Table 11 shows that the t-value is 6.04 and the standard deviation is 1.87. There is a 2.06 difference in the mean score between the retention test and the post-test. The significance value ($p < 0.05$) shows that the difference between the post-test and retention test results is statistically significant.

Table 12

Paired Samples Statistics for the Control Group

	n	*M*	*SD*	*SEM*
Post-test	30	15.20	2.72	.47
Retention test	30	10.67	2.00	.36

Table 12 shows that the mean score on the retention test dropped to 10.67, whereas the mean score on the post-test was 15.20. The standard deviation for the post-test was 2.72, and for the retention test, it was 2.00. These results indicate a significant drop in student performance over time. The control group was taught using the traditional lecture method.

Table 13

Paired Samples Correlation for the Control Group

	n	*r*	*Sig.*
Post-test & Retention test	30	.46	.009

As shown in Table 13, there was a weak positive correlation, as indicated by the correlation coefficient of 0.46, between the scores of the post-test and the retention test. This implies a comparatively low degree of retention of academic achievement between the post-test and the retention test.

Table 14

Comparison t-test for the Control Group

	Paired Differences	*t*	*df*

	M	SD	SEM	95% CI				Sig. (2-tailed)
				LL	UL			
Pair 1 Post-test & Retention test	4.53	2.51	.45	3.59	5.47	9.87	29	.001

Table 14 shows that the t-value is 6.04 and the standard deviation is 1.87. The mean difference between the scores on the retention test and the post-test is 2.06. The value of $p < 0.05$ shows that the difference between the post-test and retention test results is statistically significant.

Table 15

Group Statistics for Retention Test

Groups	n	M	SD	SEM
Experimental	30	27.63	2.02	.37
Control	30	10.67	2.00	.36

Table 15 shows that the experimental group had a mean score of 27.63, while the control group had a mean score of 10.67. The control group's standard deviation was 2.00, while the experimental group's was 2.02. The results show that there is a significant difference in retention test scores between the two groups, with the experimental group doing better than the control group.

Discussion

The effect of the ARCS model on students' academic achievement in Biology in the 9th grade has not been examined in any other study in the literature. Nonetheless, it can be said that the research's findings are comparable to those of investigations carried out in several educational scientific disciplines. Jomel (2019) asserts that the ARCS approach can enhance academic achievement (Faryadi, 2013; Ghbari, 2016; & Malik, 2014). The group statistics showed that the experimental group did much better in academic achievement than the control group. The mean score for the experimental group's post-test was 29.70, while the mean score for the control group was 15.20. This mostly signifies that the ARCS model utilised in this study enhanced the academic achievement of students. Golzari et al. (2023) assert that the ARCS model markedly enhanced students' academic motivation and performance in comparison to the control group. The study's results show that the experimental group's post-test mean scores ranged from 1.73 to 4.40, while the control group's scores ranged from 1.93 to 3.73 for attention, 2.33 to 4.36 for relevance, 2.30 to 4.26 for confidence, and 3.56 to 4.06 for satisfaction. The experimental group's mean scores on the post-test ranged from 2.33 to 4.36, while the control group's scores on the same test ranged from 1.80 to 3.50. This finding corroborates the research by Ma and Lee (2021), indicating that pupils employing the ARCS model attain higher academic performance than those who do not. This finding corroborates the research by Ma and Lee (2021), indicating that pupils employing the ARCS model get enhanced academic performance relative to their peers who do not. Roemintoyo et al. (2022) assert that the use of the ARCS model may enhance students' learning outcomes. The input derived from a sequence of ARCS-based instructions was inseparable from the enhancement of learning results. The justification for this is that the ARCS model is strongly dependent on attention (Rohmad, 2019). The elements of the ARCS model can also develop supplementary competencies, including augmenting students' motivation to engage in learning activities, promoting their capacity for self-directed learning, enhancing their critical thinking and communication skills, and improving their problem-solving abilities through the contextualization of the presented material (Candra & Retnawati, 2020). The study's results show that the experimental group's mean score changed by 18.13 from the pre-test to the post-test, using the ARCS model. This shows that the students' academic achievement improved significantly following the intervention. On the other hand, the control group, which was taught using the traditional lecture method, had a correlation coefficient of -0.11 between the pre-test and post-test. This means that there was a negative correlation and that the academic achievement of students dropped from the pre-test to the post-test. This study supports the findings of Mazaimi and Sary (2023) and Nofriansyah et al. (2024), which indicated that conventional methods of teaching, such as lectures, typically do not enhance student comprehension.

Conclusion

The results show that before the intervention, both the experimental and control groups had similar levels of academic achievement. However, after using the ARCS Model, the experimental group did much better

in school, as shown by significant increases in post-test scores, high positive correlations, and large t-test findings. The control group, on the other hand, only showed a small improvement in post-test scores with a weak association and less noticeable gains. They learned using the usual lecture method. Also, the results of the retention test showed that the experimental group kept their academic achievements over time, while the control group did worse. Overall, the findings strongly support the idea that the ARCS Model is better than the lecture-based approach to helping 9th-grade students do better in school and keep doing better.

Recommendations

The ARCS Model is a good way for teachers and curriculum developers to help students achieve better in school and remember what they learn for a long time, especially in 9th grade. Teachers may learn how to use the ARCS Model to make classes that keep students interested, show them why the material is important, boost their confidence, and make them satisfied. Educational policymakers need to think about adding motivational teaching models like ARCS to school curricula to replace or work with standard lecture approaches. Also, more studies may be done on the ARCS Model in different disciplines and grade levels to see how it can be used in a wider range of educational contexts and what benefits it can have.

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