Evaluating the Impact of the ARCS Motivational Model on Student Engagement in Blended Learning Environments: A Mixed-Methods Study among Vocational College Students

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Abstract

The mixed-method study investigates the effectiveness of the ARSC model. The objective of this investigation is to measure the impact of the ARCS model on the engagement levels of students in vocational college settings within a blended learning framework. It includes a pre-intervention and a post-intervention survey (n=255) along with a semi-structured interview (n=10). Students of Jiangsu Vocational College of Medicine have been involved in pre-intervention surveys, followed by a month of training implementing the ARCS model in blended media. Post-intervention surveys have also been conducted. Furthermore, ten students have been interviewed in-depth, individually. The quantitative analysis using paired t-test and regression analysis indicates that the engagement levels of the vocational students significantly increase after implementation of the ARCS model in blended mode, and all the elements of the model collectively significantly predict the change in the student engagement. The interview reveals certain challenges faced by the students, of which some significant ones are technical glitches, time management, confusing and unclear assignments, and so on. The findings of the study will guide the vocational teachers to tailor their blended instruction by incorporating ARCS elements to improve overall student engagement, leading to a better learning outcome.

Keywords: ARCS model, student engagement, satisfaction, vocational students.

1. Introduction

By offering specialized competencies and knowledge for certain vocations, vocational education fills the gap between academic and industrial demands. It is a crucial route for a speedy and effective entry into the industry (Berezovska et al., 2020), as it places an emphasis on real-world applications and practical experience. Notwithstanding its significance, the method and execution of vocational education pose difficulties and underscore the complexity of the subject.

Academic engagement is a significant challenge, affecting students at all educational levels (Zhao & Ko, 2020). Student engagement (SE) at vocational education is an important aspect as it influences students' completion, progression, and dropout from the course (Ross, 2010; Yates et al., 2020) along with academic success (Halverson & Graham, 2019). Clear instruction, effective teaching behaviour, efficient classroom management, and learning environments are found to be associated with SE (Bond & Bedenlier, 2019; Kyriakides, 2013; Maulana et al., 2017).

Even if discussion and theoretical progress around blended learning peaked more than ten years ago, scholars and practitioners are still quite interested in the topic. By definition, blended learning combines computer-mediated instruction or online instruction with conventional face-to-face instruction (Garrison & Kanuka, 2004; Graham, 2006). Studies in different contexts found it to be more impactful than solely face-to-face or computer-mediated learning (Bernard et al., 2014; Brodersen & Melluzzo, 2017; Stockwell et al., 2015). Technological advancements like blended learning have enabled the development of dynamic, engaging digital platforms (Dangwal, 2017), enhancing the educational environment's flexibility to cater to diverse learners' needs (Yusoff et al., 2017). This instructional modality offers flexibility and accessibility, which are particularly important for vocational learners who often balance education with other responsibilities, such as work and family commitments (Graham, 2019). The rise of digital technologies and the evolving needs of the workforce have accelerated the adoption of blended learning in vocational settings, allowing institutions to provide education that is both relevant and adaptable to the changing demands of industries (Vaughan et al., 2013). In this context, the present study intends to improve the vocational students' engagement level by implementing a motivational model, namely the ARCS model, in a blended learning environment.

2. Review of Literatures

Learning in blended mode has now become a prominent instructional medium in vocational education, combining online and technology-enhanced learning activities with regular face-to-face teaching and enhancing both flexibility and accessibility of the learners. For vocational students, who frequently juggle their education with employment or other obligations, this flexibility is essential (Boelens et al., 2017). The usefulness of blended medium in advanced vocational programs for marketing students was investigated in a study based on internet thinking. It was found that blended learning met the different instructional demands of vocational college students and dramatically increased academic achievement, program satisfaction, and learner initiative (Yanbing, 2021). A comprehensive analysis of twenty investigations on blended learning settings found that few give students control over how the blend is implemented, while face-to-face meetings usually serving as a catalyst for social interaction and online activities serving as a means of personalization and monitoring, but instructional activities that promote an affective learning climate receiving less attention (Boelens et al., 2017). Another study (Wang & Han, 2017) examined the contribution of institutions in blended instruction implementation in Chinese vocational system, highlighting six significant sub-systems: institution, educator, learning support, technology, content, and learner, which work in an organic synergy. The study found that institutions play a significant leadership role, but this role diminishes as BL

progresses. Even while blended learning increases accessibility and flexibility in vocational education, its application frequently disregards emotional learning and places an undue emphasis on institutional leadership, which reduces student autonomy and engagement.

SE is a crucial aspect of higher education, influenced by various factors and influences. According to Pye et al. (2015), and Yearwood et al. (2016), it is linked to scholastic success, positive outcomes, and student satisfaction. Regardless of the delivery method, SE is characterised by interest, enthusiasm, belonging, choice and control, deep learning, time and effort invested, interaction, self-regulation, feelings of autonomy, and participation (Fisher et al., 2021). There are several studies that investigated SE in blended media. For instance, Sahni (2019) demonstrated an improvement in both in-class and online learning outcomes and engagement where learners showed control over learning speed and became motivated. By using a mixed learning strategy, an action research project sought to enhance teaching-learning in higher education. To gather information and rethink teaching methods, three cycles of action research were carried out. The results demonstrated that hearing students out via a blended learning strategy raised engagement and gave them additional opportunities to contribute to the design and development of instruction (Shohel et al., 2020). Another project investigated the influence of instructional layout on a vocational college's capacity to use a student-centered learning strategy to improve academic SE. The study found that a redesigned vocational education module improved SE (Cunningham et al., 2024). Although blended learning has been demonstrated to increase SE, obstacles such as uneven access to technology and disparities in motivation levels may still impede its efficacy.

The ARCS motivational model, developed by Keller (1984), highlighted four elements essential for SE, namely, ‘attention (A)’, ‘relevance (R)’, ‘confidence (C)’ and ‘satisfaction (S)’. Existing studies confirmed that attention (Wu & Sarker, 2022), relevance (Zhang et al., 2023), confidence (Agung & Sutadji, 2023) and satisfaction (Syauqi et al., 2020) are particularly significant for vocational educational context. A case study on library instruction implementing the ARCS model showed increased SE (Reynolds et al., 2017). In a multi-dimensional evaluation performed in a Chinese local university, blended learning was shown to be more effective than complete online learning in terms of enhancing students' attention spans, self-assurance, and judgments of their level of satisfaction (Ma & Lee, 2021). Another investigation explored the ARCS learning model's impact on students' motivation and learning outcomes at the senior high school level, using a quantitative method and pretest-posttest control group design. Results showed significant influence on attention, relevance, confidence, and satisfaction, leading to improved learning outcomes (Afjar & Syukri, 2020). Even though the ARCS model has received a lot of validation in enhancing SE, different educational contexts will affect how successful it is, and certain studies may not take these contextual elements into account.

Despite the extensive research on blended learning and the ARCS model, a significant gap exists in understanding their combined impact on SE, specifically within vocational education settings. While studies have validated the ARCS model's effectiveness in various educational contexts, there is limited exploration of its role in enhancing engagement in blended learning environments, particularly for vocational students who face unique challenges such as balancing education with work. Thus, under this purview, the major aim of this research is to assess the

impact of the ARCS model on the engagement levels of students in vocational college settings within a blended learning framework. Figure 1 shows the conceptual framework of the study, and the following research questions and corresponding hypotheses will guide research design, analysis, and interpretation:

RQ1: Does the integration of the ARCS model in blended learning change the engagement levels of vocational students?

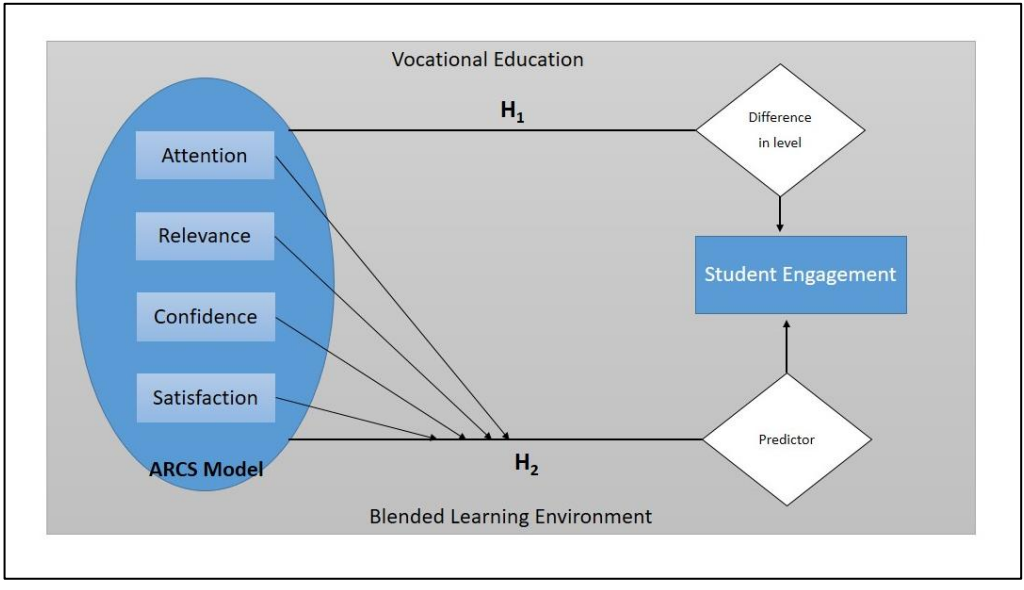
- Hypothesis 1 (H_1): The integration of the ARCS model in blended learning significantly enhances the engagement levels among vocational students.

RQ2: Does the inclusion of the ARCS model in blended learning predict the engagement levels of students?

- Hypothesis 2 (H_2): ARCS model implementation in blended learning significantly predicts the engagement level of the students.

RQ3: How do students perceive the changes in their motivation and engagement due to the ARCS model, and what specific elements of the model were most effective, and what challenges did they encounter in blended setting?

Figure 1 Conceptual Framework



Significance of the Study

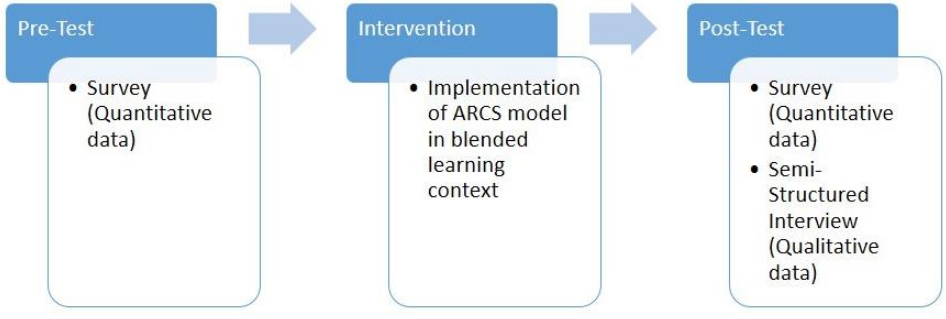
Present study's importance stems from its ability to close a significant gap in the research by examining the usefulness of the ARCS model in blended learning settings, particularly in the context of vocational education. Sustaining SE, which is essential for effective learning

outcomes, is one of the problems of blended learning (Means et al., 2013). The results of this study will contribute to the knowledge of the potential of the ARCS model to enhance SE by offering empirical data in favour of its wider application. Teachers can better address the requirements of vocational students by customising their teaching tactics by determining which elements of the ARCS model have the most influence on SE. The results of the research may be utilized for the development of curricular materials that not only provide the needed content but also better engage students by matching their interests and long-term career goals. This is especially crucial for vocational education, as student motivation is greatly influenced by how applicable the knowledge is to real-world situations (Bernard et al., 2014). When the ARCS model is implemented in classroom settings, students stand to gain immediate benefits (Wilson, 2021), making their educational experiences more fulfilling and effective.

3. Method

Research Design: To seek answers to the aforesaid research questions, a sequential mixed-method research design has been adopted. By combining the benefits of both quantitative and qualitative research, it can easily and meaningfully analyse complex research issues (Dawadi et al., 2021). It gives a logical base, flexible methodology, and scope for in-depth understanding all together (Maxwell, 2016). This research design involved a pre-test-post-test questionnaire survey (quantitative research) and a semi-structured interview (qualitative research) in order to get an enhanced insight about the effects of the implemented ARCS model on vocational college students in a blended learning context (see Figure 2). In the first phase, a pre-post test design has been used to establish the levels of motivational change amongst the existing courses, and after the ARCS-based motivational strategies are incorporated systematically in the blended learning courses over a month. In the next stage, a semi-structured interview has been conducted to explore students' experiences of the utilisation of the ARCS-based instructional design in the environment of blended learning.

Figure 2 Schematic Represtation of Research Design



Participants: Vocational students being the population of the study, 255 students were selected as samples for conducting the survey using the purposive sampling technique. Students were chosen from seven intact sections, each with 40 students from Jiangsu Vocational College of Medicine. This university was purposively selected for the research due to its diversified vocational programmes and students with varied educational, cultural, and economic backgrounds. This kind of heterogenous sample improves the generalisability of the research findings to a larger population (Cash et al., 2022). For the second stage of the qualitative study, the last question of the post-test survey questionnaire included an item to inquire about the willingness to engage in a post-study interview. Out of those interested participants, 10 students were chosen employing simple random sampling so that each academic experience category is portrayed in the results.

Research Tools:

ARCS-Based Lesson Plans: To ensure that motivational strategies were applied to increase SE, lessons were developed with consideration for the ARCS elements. Every lesson plan also contained contingency plans on how to capture and maintain the learners' attention, demonstrate the contextual value of the lesson, reinforce the learners' self-esteem, and help the students feel the lessons met their needs. Specific tactics, such as attention-grabbing multimedia, relevance to real-world applications, confidence-building feedback mechanisms, and satisfaction through achievable challenges, have been employed. A week-wise schedule plan (see Annexure 1) was developed for successful implementation of the model.

Survey Questionnaire: To assess the engagement level of the participating students before and after the implementation of ARCS-based blended instructional design and to find out the effectiveness of the ARCS model on SE, two sets of novel and researcher-made survey questionnaires have been prepared. The pre-test survey questionnaire (see Annexure 2) was prepared with an intention to assess the engagement level and motivational levels of the vocational students prior to the implementation of the ARCS model of blended learning. It consisted of three major sections. The first section was dedicated to demographic information of the students, such as age, gender, highest educational level, etc. The second section dealt with SE and consisted of five items. The third section was categorised under four sub-sections to measure four dimensions of motivation, namely 'attention', 'relevence', 'confidence', and 'satisfaction'. Each of these four sub-sections consisted of four items each. All the total 21 items were based on a five-point Likert scale, with options from strongly agree (5) to strongly disagree (1). A similar post-test survey questionnaire (see Annexure 3), without a demographic section, was prepared with the intention to assess the engagement level and motivational levels of the vocational students after implementing of the ARCS model in blended learning. Keeping the same format as the pre-test questionnaire, the first (5 items) and second (4+4+4+4=16 items) sections of the questionnaire were developed with different items. Beside this, an additional question has been included to inquire about the willingness of the students to engage in a post-study interview.

Semi-Structured Interview Schedule: To identify the perceptions of the vocational students regarding the specific impact of the ARCS model on their motivation enhancement, in addition to quantitative data, a semi-structured interview schedule (see Annexure 4) was constructed. Six

questions were framed to understand students' perceptions about the ARCS model impacting their motivation and engagement, its contributions, and challenges faced during the implementation of a blended environment. Expert validation was taken from one eminent professor of the education department of the author's university.

Validity and Reliability of the Tools: As per Table 1, the KMO value is 0.780, which is higher than the acceptability threshold of 0.6, indicating a statistically significant sample size to develop the indented model for this study. The Bartlett's test shows that the dataset is statistically significant ($p < 0.05$).

Table 1 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.780
Bartlett's Test of Sphericity	Chi-Square	4772.82
	df	210
	Sig.	0.000

The factor analysis (see Annuxre 5) for both the pre-test tool and post-test survey tools has been done using the Principle Component Extraction method while using Varimax Rotation with Keiser Normalization. The validity of the scale of student engagement in the pre-test survey (AVE= 0.590) is at an acceptable level; however, the validity of the scale could be improved further, whereas it has a good level of reliability (CR = 0.880). The scales for ARCS model components in the pre-test are at a moderate level ($0.6 < AVE < 0.8$), whereas the reliability is very high ($CR > 0.8$). Similar findings have also been found in the post-test survey tool, where the validity of student engagement (AVE = 0.557) is at an acceptable level whereas lower than others while having higher reliability. The items are loaded within the intended scales without having any parallel loading or overlapping loadings. The average of underlying loaded items has been taken to develop the index of the variables or scales for both pre-test and post-test measures.

Data Collection Process: Before conducting the study, the administrative authority of Jiangsu Vocational College of Medicine was notified regarding the research programme through an official letter mentioning the research objective, research procedures, student involvement, and implementation of the ARCS model-based blended learning by integrating it with the college curriculum for one month. After getting consent from the authority, written consents were also collected from the students as well. Seven sections were selected for the study after consulting with the authority and concerned teachers. In the first phase, before implementation of the ARCS model, students were asked to complete the pre-test survey questionnaire, and for that purpose, 20 minutes of time were allotted. In the second phase, students of the selected sections were taught using the ARCS model integrated lesson plans in a blended learning setup for one complete month. Important to mention, teachers were given special training before hand for successful dissemination of the lesson plans. In the third phase of the study, after one month of studying in the blended setting, students were again asked to complete the post-test survey questionnaire within 20 minutes. After filtering the missing responses and discontinued participants, finally, 255 responses are taken for both pre-test, post-test comparisons and inferential analysis. In the last phase, from the interested students, 10 students were selected randomly and interviewed one-to-one personally. For each candidate, 30-40 minutes were allotted, and all the interviews were audio recorded with the students' permission. Later, all the

interview recordings were heard repeatedly to prepare the transcripts verbatim. Ethical considerations are maintained throughout the research process, and all the data is kept anonymous, confidential, and used only for research purposes.

Data Analysis: The quantitative data from survey questionnaires was subjected to statistical analyses to test the hypotheses using SPSS software. To find whether there is any significant change in SE after implementation of the ARCS model-based blended learning, a paired t-test was performed. Further, to measure the predictive nature of the model to influence SE regression analysis was employed. For the qualitative study, the transcripts were translated into English by a certified language expert. These translated transcripts of ten interviews were analysed thematically by using NVivo 10 software. Relevant themes and codes were identified with an intention to seek an answer to the research question.

4. Results

Findings from Survey Study

Table 2 indicates that most of the participants are 18-24 years old (47.06%), whereas some of them are 25 to 34 years old (35.29%). The distribution of male and female participants is almost equal, whereas male (54.51%) participants are marginally higher than female (44.31%) participants. A larger number of participants have an associate degree (44.71%), whereas a large number of participants have a high school diploma, or GED (32.94%), and a bachelor's degree (20%). Around 81% of the participants have within 2 years of experience in the educational program whereas only 4% of them have more than 4 years of experience.

Table 2 Demographic Characteristics of Participants

		Count	N %
Age	<18	4	1.57%
	18-24	120	47.06%
	25-34	90	35.29%
	35-44	41	16.08%
Gender	Male	139	54.51%
	Female	113	44.31%
	Prefer not to say	3	1.18%
Education	High school diploma or GED	84	32.94%
	Associate degree	114	44.71%
	Bachelor's degree	51	20.00%
	Postgraduate degree	6	2.35%
Program Duration	< 1 year	128	50.20%
	1-2 years	78	30.59%

3-4 years	38	14.90%
> 4 years	11	4.31%

Descriptive Statistics, Correlation and Comparisons of Variables

As per Table 3, age is negatively associated with attention ($r = -0.363$, $p < 0.05$), relevance ($r = -0.136$, $p < 0.05$), confidence ($r = -0.159$, $p < 0.05$), and satisfaction ($r = -0.159$, $p < 0.05$) at the pre-test level. It implies that before intervention, the existing level of attention, relevance, confidence, and satisfaction are lower in older students compared to younger students. Confidence level before intervention is positively associated with attention, relevance, satisfaction, and engagement level.

Table 3 Correlation between Pre-test Variables and Demographic Characteristics

		1	2	3	4	5	6	7	8	9
1	Age	1	-0.085	0.001	0.058	-.363**	-.136*	-.172**	-.159*	0.003
2	Gender (Female)	-0.085	1	0.113	0.041	0.025	0.071	.137*	0.028	0.083
3	Education	0.001	0.113	1	.146*	-0.073	0.084	-0.068	-0.092	-0.119
4	Program_Duration	0.058	0.041	.146*	1	.187**	0.04	.144*	0.07	.160*
5	Attention_pre	-.363**	0.025	-0.073	.187**	1	.271**	.518**	.348**	.313**
6	Relevance_pre	-.136*	0.071	0.084	0.04	.271**	1	.127*	.140*	.144*
7	Confidence_pre	-.172**	.137*	-0.068	.144*	.518**	.127*	1	.231**	.478**
8	Satisfaction_pre	-.159*	0.028	-0.092	0.07	.348**	.140*	.231**	1	.218**
9	Student_Engagement_pre	0.003	0.083	-0.119	.160*	.313**	.144*	.478**	.218**	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 4 Descriptive Details of Variable Indexes for Pre-test and Post-test

	Mean	Median	Std. Dev	Min	Max
Attention_pre	2.9333	2.75	1.111	1	5.25
Attention_post	3.7716	4	1.0868	1	5
Relevance_pre	2.9922	3	0.812	1.5	4.75
Relevance_post	3.752	3.75	0.8765	1.5	5
Confidence_pre	2.9961	3	0.9022	1	5
Confidence_post	3.9118	4	0.9152	1.75	5
Satisfaction_pre	3.1039	3	0.7678	1.5	4.5
Satisfaction_post	3.8569	4	0.7913	2	5
Student_Engagement_pre	2.7498	2.8	0.9428	1.2	4.6

Student_Engagement_post	3.5278	3.8	0.9775	1	5

As per Table 4, in all aspects, the mean scores of the post-test are higher than the pre-test, which shows that the average level of all aspects has improved after the ARCS intervention. As per Table 5, it has been found that for all aspects, including attention, relevance, confidence, satisfaction, and SE, there is a statistically significant difference between pre-test and post-test scores ($p < 0.05$). Therefore, H_1 is accepted. However, the maximum difference from the pre-test to the post-test has been found in satisfaction level ($t = 21.864$, $p < 0.05$), whereas comparatively lower significant improvement has been found in SE ($t = 12.384$, $p < 0.05$). Attitude ($t = 17.288$, $p < 0.05$) is comparatively lower, however, there is significant improvement after intervention.

Table 5 Paired Sample t-Test Results for Pre-Test Post-Test Comparisons

	Mean	Std. Dev	Std. Err	95% CI of Difference		t	P > | t |
				Lower	Upper		
Attention_post_Attitude_pre	0.838	0.774	0.048	0.743	0.934	17.288	0.000
Relevance_post_Relevance_pre	0.760	0.574	0.036	0.689	0.831	21.133	0.000
Confidence_post_Confident_pre	0.916	0.693	0.043	0.830	1.001	21.104	0.000
Satisfaction_post_Satisfaction_pre	0.753	0.550	0.034	0.685	0.821	21.864	0.000
Student_Engagement_post _Student_Engagement_pre	0.778	1.003	0.063	0.654	0.902	12.384	0.000

Correlation of Pre-test Post-test Difference and Regression with Diagnostic Analysis

As per Table 6, age is negatively correlated with relevance ($r=-0.164$, $p<0.5$) and SE ($r=-0.149$, $p<0.05$), indicating higher age is associated with lower improvement in perceived relevance and SE. People with higher educational qualifications had higher improvement in SE ($r=0.255$, $p<0.05$). The improvement in confidence level is significantly correlated with the improvement in attention ($r=0.301$, $p<0.05$), satisfaction ($r=0.207$, $p<0.05$), and engagement ($r=0.115$, $p<0.05$). The engagement is not associated with gender or program duration. The correlation coefficients of all predictors are low to moderate ($r<0.5$). Therefore, there is no risk of multi-collinearity.

Table 6 Correlation Analysis and Demographic Characteristics

		1	2	3	4	5	6	7	8	9
1	Age	1	-0.085	0.001	0.058	0.058	-.164**	-0.029	-0.005	-.149*
2	Gender (Female)	-0.085	1	0.113	0.041	.168**	.293**	.250**	0.002	0.095
3	Education	0.001	0.113	1	.146*	0.088	.187**	.218**	.358**	.256**
4	Program_Duration	0.058	0.041	.146*	1	-0.028	-.141*	-0.033	.257**	0.07
5	Attention_diff	0.058	.168**	0.088	-0.028	1	0.09	.301**	.172**	.266**

6	Relevance_diff	-.164**	.293**	.187**	-.141*	0.09	1	0.087	-0.049	.192**
7	Confidence_diff	-0.029	.250**	.218**	-0.033	.301**	0.087	1	.207**	0.115*
8	Satisfaction_diff	-0.005	0.002	.358**	.257**	.172**	-0.049	.207**	1	.276**
9	Student_Engagement_diff	-.149*	0.095	.256**	0.07	.266**	.192**	0.115	.276**	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

As per Table 7, the change in attention, relevance, confidence, and satisfaction due to intervention can predict only 16% variability of SE (R-square = 0.16), which indicates there could be other factors that are also influencing the improvement in SE. As per the ANOVA results of the model, the chosen factors collectively can statistically significantly predict the change in SE ($F = 11.881$, $p < 0.05$) from the pre-test to the post-test. Therefore, H_2 is accepted.

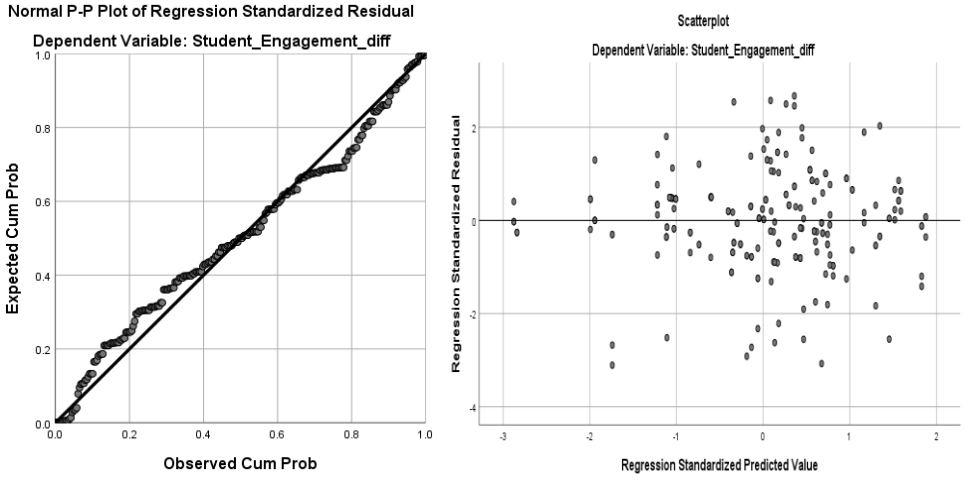
Table 7: Effect of Intervention on Student Engagement Level

Model Summary					
R	R Square	Adjusted R Square	SE of the Estimate		
0.400	0.16	0.146	0.927		
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	40.832	4	10.208	11.881	0.00
Residual	214.805	250	0.859		
Total	255.637	254			
Coefficients					
	B	Std. Error	Beta	t	Sig.
(Constant)	-0.023	0.141		-0.164	0.870
Attention_diff	0.273	0.08	0.21	3.428	0.001
Relevance_diff	0.327	0.102	0.187	3.197	0.002
Confidence_diff	-0.025	0.09	-0.017	-0.283	0.777
Satisfaction_diff	0.462	0.109	0.253	4.227	0.000

Dependent Variable: Student Engagement diff

As per Table 7, the changes in satisfaction ($B=0.462$, $p<0.05$) due to the intervention have the strongest positive and significant effect on the changes in SE level. The changes in perceived relevance ($B=0.327$, $p<0.05$) have the second most significant effect on the improvement of SE due to intervention. The improvement in attention due to intervention ($B = 0.273$, $p < 0.05$) affects positively and significantly on the enhancement of SE as well. However, no independent effect of confidence has been found on SE in this regression model, despite having a correlation between them. Considering the association between confidence and other predictors, it can be assumed that confidence level could have an indirect effect on the improvement of SE rather than having a direct and uniquely independent effect.

Figure 3 Residual P-P Plot (Left) and Residual vs Predicted Plot (Right)



As per P-P of the residual at the left figure in Figure 3, the residuals follow the diagonal normal line, which shows the normal distribution of residuals. Therefore, the normality of the assumptions of the regression model is satisfied. However, in the scatter plot on the right side, there is an emerging funnel-like structure, indicating a possible risk of heteroscedasticity. Therefore, further improvement of the model is needed in future considering more confounding variables to enhance the robustness of the model.

Findings from Semi-Structured Interview

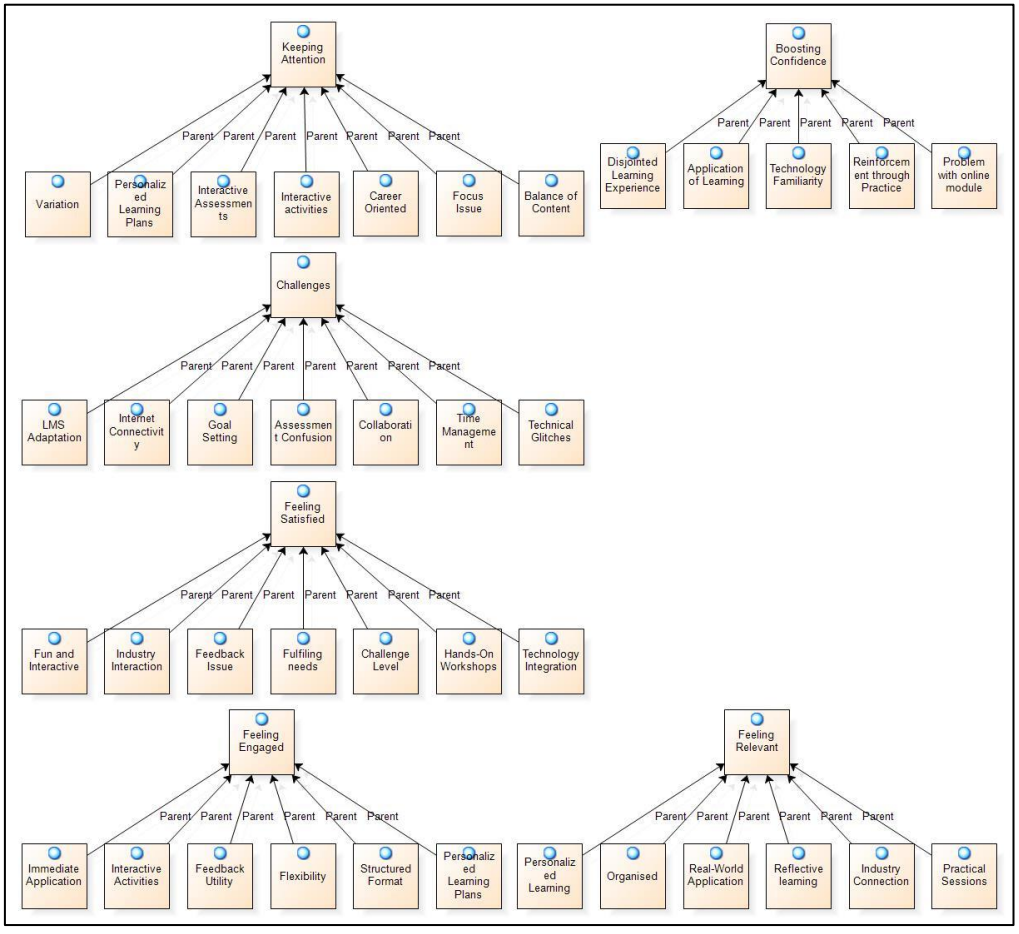
As indicated from Table 8, the interviewees in the sample are reflecting diversity in terms of age, educational qualification, and programme duration. The students are given codes as P1 to P10 to keep anonymity. Male and female students are represented almost equally.

Table 8 Sample Profile of the Interviewee

Student ID	Age Range	Gender	Education	Program Duration
P1	18-24	Male	High school diploma or GED	1-2 years
P2	25-34	Female	Associate degree	3-4 years
P3	18-24	Female	High school diploma or GED	1-2 years
P4	35-44	Male	Bachelor's degree	3-4 years
P5	18-24	Male	Associate degree	1-2 years
P6	25-34	Female	Bachelor's degree	3-4 years
P7	18-24	Prefer not to say	High school diploma or GED	1-2 years
P8	35-44	Female	Postgraduate degree	More than 4 years
P9	18-24	Male	Associate degree	1-2 years
P10	25-34	Female	Bachelor's degree	3-4 years

The ten interview transcripts have been used as sources. Six parent nodes are identified, namely, keeping attention, feeling relevant, boosting confidence, feeling satisfied, feeling engaged, and challenges. Under each parent node, several sub-nodes are identified from the thematic analysis of the transcripts, which are presented in Figure 4.

Figure 4 Sources, Parent Nodes and Sub-Nodes



Keeping Attention

The students' responses reveal that interactive and technology-enhanced activities, such as smartboard games, LMS challenges, and AR/VR simulations, were particularly effective in capturing and maintaining their attention. The variety of course materials, including expert webinars and career advancement workshops, also contributed to engagement, especially when they aligned with students' professional goals.

The interactive assessments were a strong point for me. They provided immediate feedback, which helped me stay on track. (P4)

…directly linked to my professional goals, which kept me highly engaged. (P10)

However, some students found the introductory technology sessions and certain online modules unable to hold their attention, describing them as too basic, repetitive, or lengthy.

I sometimes found it hard to stay focused during the longer multimedia presentations. (P1)

Collaborative projects and peer review sessions received mixed reactions; while some found them beneficial, others struggled with focus and found the sessions rushed.

Feeling Relevant

The blended learning course effectively made the content feel relevant to most students by connecting theoretical knowledge to real-world applications. Many students highlighted the importance of practical sessions, personalized learning plans, and expert webinars in demonstrating how course concepts could be applied in their future careers. The capstone projects, which involved real-world tasks and feedback from industry professionals, were particularly impactful in making the content feel immediately relevant. The use of digital tools and technology, such as smartboards and AR/VR simulations, also helped students see the practical value of the skills they were learning. However, a few students mentioned that some early sessions and online modules felt less relevant, either due to their basic nature or lack of immediate application. Overall, the course succeeded in making the content feel meaningful, especially when it focused on practical, career-oriented activities.

Hearing from industry experts made the information more credible and applicable to my future work. (P3)

It wasn't just about learning new tech; it was about seeing how it will be used in my field. (P5)

Boosting Confidence

The blended learning activities and assessments contributed to students' confidence in mastering the course material, though the extent varied. Many students found that the combination of online learning, interactive quizzes, and practical workshops helped reinforce their understanding and build confidence.

…practical sessions allowed me to reinforce what I had learned. By the time we started the capstone project, I felt much more prepared. (P3)

Peer review sessions and collaborative projects also played a crucial role, offering feedback that boosted confidence in their abilities. However, some students felt that the online components, while informative, were less impactful in building confidence compared to the in-person workshops. A few students struggled with the assessments, finding them too simplistic or not well-integrated with the practical aspects of the course.

I didn't feel truly confident until we got into the hands-on practical workshops. (P7)

Feeling Satisfied

Overall, students expressed moderate to high satisfaction with the learning experiences provided by the course. They appreciated the course's structure, particularly the balance between theory and practical application, and valued the interactive elements such as smartboard games, AR/VR

simulations, and collaborative projects. These components were highlighted as engaging and directly relevant to their future careers, which contributed to a positive learning experience. However, some students noted areas for improvement. A few felt that the online modules could have been more concise or interactive, and some found the technology integration, particularly in the early sessions, overwhelming or basic. Others suggested that more frequent feedback and peer review sessions would have enhanced their experience.

My only critique is that the course could have had more frequent feedback sessions throughout the duration, not just at the end. (P6)

Despite these challenges, the majority of students were satisfied with the blend of technology and traditional methods, with particular praise for the professional development sessions, hands-on workshops, and real-world relevance of the course content.

Feeling Engaged

Students generally found that the blended learning course significantly improved their engagement. The flexibility of online modules allowed students to learn at their own pace, while the practical workshops and hands-on activities provided immediate application of theoretical knowledge, which many found motivating. The structured format of the course, with a clear progression from online learning to practical application, also contributed to sustained engagement. Personalized learning plans and adaptive learning sessions helped students focus on their specific needs, enhancing their connection to the material.

Being able to go through the theoretical content at my own pace allowed me to focus more during the hands-on sessions. (P3)

The structured format of the course, with a clear progression from theory to practice, kept me engaged. (P8)

Challenges

The students reported encountering few challenges while engaging in the blended learning environment. A common issue was adapting to the Learning Management System (LMS) and other digital tools, with some students finding the initial training overwhelming and confusing. Time management was another frequent concern, especially for those balancing coursework with other responsibilities. They encountered confusion with interactive assessments and unclear expectations for quizzes and discussion assignments. Several students struggled with the collaborative projects, citing difficulties in coordinating with peers and maintaining focus during the planning phases. Technical glitches and issues, such as navigating the LMS features and understanding adaptive learning technologies, also posed challenges. However, they suggested that more support and guidance would have been beneficial.

One major challenge for me was the inconsistency in internet connectivity, especially during online modules. It disrupted my learning flow and made it hard to engage with the multimedia presentations and quizzes. (P2)

Collaborative projects were challenging because of varying levels of participation from team members. Coordinating on digital platforms was tricky, and we sometimes had issues with communication and task management. (P6)

The major keywords and word frequency from the interview data are presented through word cloud in Figure 5. It highlights that the terms and their synonymous terms learning (6.70%), blended (3.09%), practicality (3.45%) and engaging (2.38%) are maximally mentioned in the interview responses.

Figure 5 Word Cloud Indicating Major Keywords and their Frequency

5. Discussion

The intention of the study was to find out the impact of the ARCS model on the engagement levels of students in vocational college settings under a blended learning framework. The findings of the quantitative data revealed that there is a significant change in SE after implementation of the ARCS model through blended mode. This is in the same line as another study (Wilson, 2021) that also found improvement in SE and motivation after applying the ARCS model. The maximum difference in satisfaction level was found. In distance literacy programmes, where the ARCS model was used, a significant difference was also found in the satisfaction level of the students (Lee & Kim, 2022). According to Lee and Kim (2022), being able to replay the learning videos and learn new things gave them this satisfaction. The present

interview revealed the detailed course structure involving both theoretical and practical exposure in balance along with interactive activities is the major source of their moderate to high level of satisfaction from the intervention. Moreover, age was negatively correlated with relevance and SE, suggesting that higher age is associated with lower improvement in perceived relevance and engagement. The meta-analysis by Dinçer (2020) also found that the ARCS model best works with a younger age group. According to that study, attention is the most effective component, and young learners become easily attentive after implementing a novel approach (Dinçer, 2020). Further, people with higher educational qualifications showed higher improvement in SE. The prior knowledge can influence their learning of new concepts (Bransford et al., 2000), whereas higher-qualified learners are typically more adept at self-regulation and employing effective learning strategies (Zimmerman, 2002) that can lead to their higher improvement in engagement level.

The ANOVA results showed that the components of the ARCS model collectively can statistically and significantly predict the change in SE. According to Mandernach et al. (2011), engagement in education is higher when students are internally forced to perform well in their tasks, invested in their motivation to learn, and prepared to put in the time and effort required by the task. The changes in satisfaction had the strongest and most significant positive effect on the changes in SE level. Another recent study (Rebusa et al., 2024) with university students also reported academic satisfaction of the student as the only significant predictor of SE. Satisfaction was found to be significantly associated with different dimensions of engagement in an online learning setting (Baloran et al., 2021). The interview reflected that the interactive activities like smartboard games, AR/VR simulations, and collaborative projects contributed to their satisfaction. The changes in perceived relevance had the second most significant effect on the improvement of SE due to the intervention. The personalised lesson plans and instant application in real-world situations made the content relevant to their future career. According to research (Raj & VG, 2022) that used machine learning approaches, relevance, as evaluated by click activity, is also found as an important predictor of SE in virtual educational settings. The improvement in attention also had a significant positive effect on the enhancement of SE. The interactive and technology-mediated activities, aligned with their career target, played a significant role here. In this context, attention-tracking technology can help improve online classrooms by tracking student attention, enhancing interaction, and raising overall engagement (Sharma et al., 2023). However, there was no independent effect of confidence on SE in this regression model, suggesting that confidence level could have an indirect effect on the improvement of SE rather than having a direct and uniquely independent effect.

The in-depth interview revealed that students faced challenges in the blended learning environment, including adapting to the Learning Management System (LMS), time management, confusion with interactive assessments, unclear expectations for quizzes and discussion assignments, and difficulties with collaborative projects. Technical glitches and understanding adaptive learning technologies also posed challenges. These challenges might have contributed to the lower confidence among the students. Some students suggested that more support and guidance would have been beneficial.

6. Conclusion

This study aimed to evaluate the impact of the ARCS model on SE within vocational college settings using a blended learning framework. The findings indicated a significant improvement in SE post-implementation, with the most substantial increase observed in student satisfaction. The structured balance between theoretical and practical elements, along with interactive activities, contributed to this satisfaction. The findings also confirmed that the components of the ARCS model collectively predict changes in SE, with satisfaction having the strongest effects followed by relevance. Despite these positive outcomes, students faced few challenges in adapting to the blended learning environment, particularly in areas like time management, interactive assessments, and technical issues with adaptive learning technologies, suggesting a need for additional support and clearer guidance to optimize the learning experience.

Limitations of the study include a focus on a specific vocational college setting, which might restrict the generalisability of the results to other educational contexts. Additionally, the dependence on self-reported data may introduce biases, and the short study duration may not capture long-term effects of the ARCS model on SE. Future research could explore the impact of the ARCS model across diverse educational environments and demographics, and employ longitudinal designs to assess sustained engagement. Incorporating more objective measures of engagement and examining the role of individual differences in response to the ARCS model would also be valuable.

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