PERINATAL JOURNAL

Original Article

Perinatal Journal 2026; 34(1):635-646

https://doi.org/10.57239/prn.26.03410067

# Extended flipped classroom with HTML5 package integration in Moodle: Impact on instructional motivational design among informatics students at universities Wijaya Kusuma Surabaya

Tjatursari Widiartin[1]*, Yatim Riyanto[2], Andi Kristanto[2]

[1]Faculty of Education, Universitas Negeri Surabaya, Indonesia, Faculty of Engineering, Universitas Wijaya Kusuma Surabaya, Indonesia
[2]Faculty of Education, Universitas Negeri Surabaya, Indonesia

**Abstract**

This study examines the impact of the Extended Flipped Classroom with HTML5 Package integration in Moodle on instructional motivational design among Informatics students at Universitas Wijaya Kusuma Surabaya. Grounded in the ARCS motivational framework (Attention, Relevance, Confidence, and Satisfaction), this research aims to determine whether the intervention enhances students' instructional motivation compared with conventional Moodle-based learning. A quasi-experimental design with a pretest–posttest control group was employed, involving 70 third-semester Informatics students divided into experimental and control groups. Data were collected using a validated ARCS-based motivational questionnaire and analyzed using PERMANOVA for multivariate effects and Mann–Whitney U tests for overall and individual ARCS components. The findings reveal significant differences between groups, indicating that the Extended Flipped Classroom with H5P integration significantly improves overall instructional motivation as well as each ARCS component individually. The experimental group demonstrated higher motivation levels with more stable score distributions compared with the control group. These results indicate that systematic integration of interactive HTML5 Package content across pre-class, in-class, and after-class phases effectively strengthens students' motivational engagement. The study concludes that the Extended Flipped Classroom model provides a promising instructional strategy for enhancing motivational learning design in technology-enhanced higher education environments.

**Keywords:** Extended flipped classroom, HTML5 package, Moodle, Instructional motivational design

## Introduction

The flipped classroom has recently gained attention in higher education due to its ability to move direct instruction outside the traditional classroom and to support active learning processes during face-to-face sessions (Baig & Yadegaridehkordi, 2023) (Faro et al., 2024). Research in educational technology shows that flipped learning can enhance student engagement, participation, and academic outcomes by encouraging learners to engage with content before class and apply higher-order thinking during class time (Lin et al., 2023) (Dan & Mohamed, 2024). However, many flipped classroom implementations focus mainly on the logistics of content sequencing and neglect the systematic design of motivational elements that sustain learner engagement throughout all phases of learning.

Instructional motivational design is fundamental to ensuring that learning activities not only deliver content but also stimulate and maintain student motivation. The Attention, Relevance, Confidence, and Satisfaction (ARCS) model developed by Keller (Keller, 1987) provides a theoretical framework for incorporating motivational strategies into instructional design (Mei et al., 2025). The ARCS model posits that attention can be captured through varied stimuli, relevance can be established by connecting learning with learners' needs, confidence can be built by structuring achievable challenges, and satisfaction can be fostered through positive reinforcement and feedback. Systematic reviews reveal that the ARCS model has been widely applied to instructional design across different educational contexts, and its principles consistently improve learner motivation, engagement, and performance in both offline and online learning environments. Empirical evidence from a 2025 study demonstrates that incorporating the ARCS motivational model into flipped classroom designs has a significant positive impact on students' deep learning, highlighting the importance of motivational strategies in effective instructional design. (Zhou & Zhang, 2025).

Advances in educational technology, such as the

**Correspondence:** Tjatursari Widiartin, Faculty of Education, Universitas Negeri Surabaya, Indonesia, Faculty of Engineering, Universitas Wijaya Kusuma Surabaya, Indonesia, **e-mail:** widiartin@gmail.com, **Received:** November 26, 2025 **Accepted:** January 1, 2026

integration of HTML5 Package (H5P) within Moodle, offer new opportunities to support interactive and motivational learning experiences (Rahadiani et al., 2024). H5P is an open-source framework that allows educators to create interactive content such as quizzes, interactive videos, games, and simulations that can be embedded directly into Moodle courses. Research on the use of H5P in blended learning environments suggests that interactive content can enhance student skills, knowledge retention, and satisfaction with learning activities. These interactive elements, when purposefully designed, have the potential to support components of the ARCS model by capturing students' attention and increasing satisfaction with the learning process (Rahmi et al., 2024).

Despite these developments, a number of gaps remain in the current literature. First, existing flipped classroom research often concentrates on cognitive outcomes or general engagement without explicitly framing instructional activities within a motivational design theory such as ARCS (Fang et al., 2024). Second, although interactive technologies like H5P are increasingly adopted, few studies examine how such technology can be integrated systematically to support motivational design across pre-class, in-class, and post-class phases. Third, within the context of Indonesian higher education, empirical evidence on ARCS-based instructional motivational design for informatics students remains scarce, particularly in private university settings (Srimaryani et al., 2023).

To address these gaps, this study proposes an Extended Flipped Classroom with HTML5 Package Integration in Moodle that is explicitly designed using the ARCS motivational framework. This study positions H5P not merely as an interactive technological tool but as a core component of a systematic motivational instructional design. The design intentionally embeds ARCS principles into structured learning activities before, during, and after face-to-face sessions. By focusing on Informatics students at Universitas Wijaya Kusuma Surabaya, this study contributes contextually relevant evidence for motivational design practices in technology-enhanced learning in Indonesian higher education.

Therefore, this study aims to examine how an extended flipped classroom supported by H5P integration in Moodle influences instructional motivational design within the ARCS framework among Informatics students. The findings are expected to enrich the literature on motivational instructional design in blended learning environments and provide practical guidance for lecturers to design flipped learning experiences that are both pedagogically and motivationally effective.

## Problem statement

Although flipped classroom approaches supported by Moodle have demonstrated potential to improve student engagement and learning outcomes, many implementations still emphasize content delivery restructuring rather than systematic motivational design (Sung & Huang, 2022). As a result, instructional practices frequently overlook the importance of explicitly embedding motivational strategies that sustain students' attention, perceived relevance, academic confidence, and learning satisfaction. At the same time, HTML5 Package (H5P) technology offers interactive learning opportunities, but its integration is often used merely as a technological enhancement instead of being connected to an instructional motivational framework (Keedle et al., 2024) (Huff & Tseng, 2025) (Ki, 2025). Consequently, there is limited empirical evidence demonstrating how an Extended Flipped Classroom with H5P Integration in Moodle (Wehling et al., 2021) (Mutawa et al., 2023) (Jacob & Centofanti, 2024) (Abidaturrosyidah et al., 2024; Abbas et al., 2025), explicitly grounded in the ARCS motivational model, can strengthen instructional motivational design among Informatics students in Indonesian higher education (Zhou & Zhang, 2025).

## Research Questions

1. To what extent does the Extended Flipped Classroom with HTML5 Package Integration in Moodle influence the Attention component of students' instructional motivation?
2. To what extent does the intervention influence the Relevance component of students' instructional motivation?
3. To what extent does the intervention influence the Confidence component of students' instructional motivation?
4. To what extent does the intervention

influence the Satisfaction component of students' instructional motivation?
5. How does the Extended Flipped Classroom with H5P integration collectively influence overall instructional motivational design within the ARCS framework among Informatics students?

## Research objectives

1. To analyze the effect of the Extended Flipped Classroom with HTML5 Package Integration in Moodle on students' Attention in learning.
2. To examine the effect of the intervention on the Relevance of learning experiences perceived by students.
3. To investigate the effect of the intervention on students' Confidence in accomplishing learning tasks.
4. To determine the effect of the intervention on students' Satisfaction with the learning process.
5. To evaluate the overall contribution of the Extended Flipped Classroom with H5P integration to instructional motivational design based on the ARCS model among Informatics students at Universitas Wijaya Kusuma Surabaya.

## Hypotheses development

The hypotheses were developed based on the conceptual framework of the study, as illustrated in Figure 1.

## Multivariate effect on ARCS motivational components

According to the ARCS motivational framework, students' instructional motivation consists of four interrelated components: Attention, Relevance, Confidence, and Satisfaction. When a learning intervention meaningfully enhances students' motivation, it should produce a simultaneous and collective effect on these components rather than influencing only isolated dimensions. Given that the Extended Flipped Classroom with H5P integration provides interactive learning materials, autonomy in pre-class learning, and engaging feedback mechanisms, it is expected to influence the overall motivational profile of students in a multivariate manner.

**H1m:** There is a significant multivariate effect of the Extended Flipped Classroom with H5P integration on the combined ARCS motivational components compared to the control group

**H0m:** There is no significant multivariate effect of the Extended Flipped Classroom with H5P integration on the combined ARCS motivational components compared to the control group

## Overall instructional motivation

In addition to examining the multivariate effect, it is essential to determine whether the intervention contributes to a general improvement in students' instructional motivation. Integrating interactive H5P learning materials within the Extended Flipped Classroom environment is designed to create a more engaging, meaningful, and satisfying learning experience. Therefore, the intervention is expected to enhance students' overall instructional motivation within the ARCS framework.

**H1:** There is a significant difference in students' overall instructional motivation within the ARCS framework between the experimental group and the control group after the intervention.

**H0:** There is no significant difference in students' overall instructional motivation within the ARCS framework between the experimental group and the control group after the intervention.

## Effects on individual ARCS components

To gain a more comprehensive understanding of how the intervention influences students' motivation, each ARCS component is examined individually. This provides more detailed empirical evidence regarding which motivational aspects benefit the most from the intervention.

## Attention

Interactive multimedia elements, quizzes, branching scenarios, and engaging tasks within H5P are expected to capture and sustain students' attention.

**H1a:** Students in the experimental group will

demonstrate significantly higher Attention motivation scores than students in the control group after the intervention.

**H0a:** There is no significant difference in Attention motivation scores between the experimental group and the control group.

### Relevance

Meaningful learning contexts, real-world problem integration, and clearer learning goals are expected to increase students' perception of relevance.

**H1b:** Students in the experimental group will demonstrate significantly higher Relevance motivation scores than students in the control group after the intervention.

**H0b:** There is no significant difference in Relevance motivation scores between the experimental group and the control group.

### Confidence

**H1c:** Students in the experimental group will demonstrate significantly higher Confidence motivation scores than students in the control group after the intervention.

**H0c:** There is no significant difference in Confidence motivation scores between the experimental group and the control group.

### Satisfaction

**H1d:** Students in the experimental group will demonstrate significantly higher Satisfaction motivation scores than students in the control group after the intervention.

**H0d:** There is no significant difference in Satisfaction motivation scores between the experimental group and the control group.

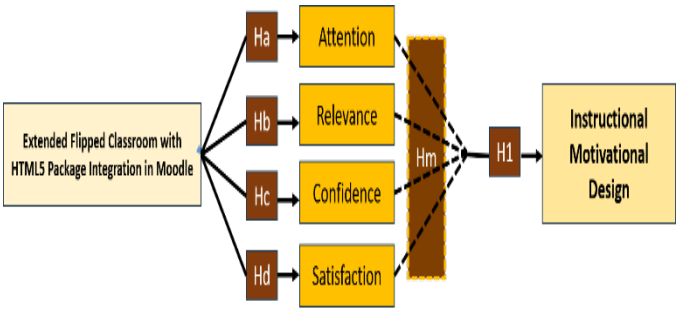


**Figure 1.** A conceptual framework of the factors that influence instructional motivational design among Informatics students

## Research Method

This study employed a quasi-experimental research design with a pretest–posttest control group approach to examine the effect of the Extended Flipped Classroom with HTML5 Package (H5P) Integration in Moodle on students' Instructional Motivational Design based on the ARCS framework. The selection of a quasi-experimental design was based on institutional constraints that did not allow random assignment of students to classes. Therefore, intact classes were used as experimental and control groups while maintaining equivalence through pretest measurement (Lee & Son, 2024). The design structure is outlined in Table 1.

**Table 1.** The design structure

| Group | Pretest | Treatment | Posttest |
|---|---|---|---|
| Experimental Group | O1 | Extended Flipped Classroom with HTML5 Package Integration in Moodle | O2 |
| Control Group | O1 | Conventional Moodle-Based Learning | O2 |

### Population and sample

The population consisted of undergraduate Informatics students enrolled in Automata or related computing courses at Universitas Wijaya Kusuma Surabaya. The sample was selected using purposive sampling, with two comparable classes assigned as:

1. **Experimental group:** Students receiving Extended Flipped Classroom learning supported by structured H5P interactive activities.

2. **Control group:** Students receiving conventional Moodle-supported learning without structured ARCS-based design.

Sample size follows recommendations for educational quasi-experiments, ensuring each group meets minimum statistical power requirements.

## Research variables

### Independent variable

Extended Flipped Classroom with HTML5 Package Integration in Moodle

(treatment applied only to the experimental group)

### Dependent variables (ARCS components)

Attention, Relevance, Confidence, Satisfaction

### Outcome variable

Instructional Motivational Design (overall ARCS construct)

### Operational definition of variables

**Attention:** Students'perceived focus, curiosity, and engagement generated through instructional activities.

**Relevance:** Perceived usefulness, personal meaning, and alignment of learning materials with academic and professional needs.

**Confidence**: Students' belief in their capability to successfully perform learning tasks.

**Satisfaction:** Students' perceived pleasure, fulfillment, and positive emotional response to learning experiences.

**Instructional Motivational Design:** A composite construct reflecting the integration and effectiveness of the four ARCS elements in learning.

### Treatment procedure

**Experimental group:** Implementation of Extended Flipped Classroom with H5P Integration, consisting of:

#### Pre-Class phase

Interactive videos, diagnostic quizzes, and preparatory learning materials using H5P.

#### In-Class phase

Problem-based activities, collaborative tasks, and guided discussion supported by LMS.

#### After-Class phase

Reflective activities, enrichment exercises, feedback-based tasks, and formative assessments.

Each phase explicitly incorporated ARCS elements:

- Attention through visual interactivity and engaging tasks
- Relevance through contextualized and meaningful learning materials
- Confidence through scaffolded activities and feedback
- Satisfaction through reinforcement and achievement acknowledgment

### Control group

Learning conducted using standard Moodle activities such as readings, standard quizzes, and basic discussion forums without structured ARCS-based design or H5P integration.

### Research instrument

Instructional motivation was measured using an ARCS-based Motivational Questionnaire, adapted from Keller's Instructional Materials Motivation Survey (IMMS) and validated for higher education contexts (Cook & Pankratz, 2024). The instrument employed a 7-point Likert rating scale (1 = strongly disagree to 7 = strongly agree) to measure students' perceptions of the four ARCS components, namely Attention, Relevance, Confidence, and Satisfaction. The instrument consists of a pretest for both the experimental and control groups, a posttest for the experimental group, and a posttest for the control group. Instrument validation included content validation, construct validation, and reliability

testing. The instrument underwent a pilot test involving 64 fifth-semester Informatics students at Universitas Wijaya Kusuma Surabaya. Reliability analyses were subsequently performed using Jamovi version 2.6.64.

### Content validation

The IMMS instrument developed by Keller (Keller, 1987) based on the ARCS model has been widely validated in subsequent research (Afjar et al., 2020). In this study, content validation was conducted by two experts, consisting of an instructional design expert and an automata subject-matter expert, to ensure the relevance and appropriateness of the instrument within the context of Informatics education.

### Reliability testing

As shown in Table 2, the reliability analysis indicates excellent internal consistency for all ARCS components and the overall scale. The Cronbach's alpha values for Attention (0.906), Relevance (0.952), Confidence (0.936), and Satisfaction (0.943) all exceed the 0.90 threshold, indicating very high reliability. The overall ARCS construct also demonstrates outstanding reliability with a coefficient of 0.981. Since all values are far above the acceptable minimum of 0.70, the instrument can be considered highly reliable for measuring instructional motivational design within the ARCS framework, as shown in Table 2.

**Table 2.** Reliability testing of instrument

| | Cronbach's α |
|---|---|
| Attention | 0.906 |
| Relevance | 0.952 |
| Confidence | 0.936 |
| Satisfaction | 0.943 |
| ARCS | 0.981 |

### Data collection procedure

1. Administer pretest ARCS motivation questionnaire to both groups.
2. Conduct treatment for several instructional sessions.
3. Administer posttest motivation questionnaire.
4. Collect additional observation data if required to support interpretation.

### Data analysis technique

Data were analyzed using:

1. Descriptive Statistics: Mean, standard deviation, and distribution analysis for each ARCS component.
2. Assumption Testing: Normality and homogeneity.
3. Inferential Analysis: PERMANOVA for multivariate ARCS analysis, Mann-Whitney U for Overall Instructional Motivation analysis and Effects on Individual ARCS Components Independent analysis.

Hypothesis testing corresponded to:

1. Multivariate ARCS
2. Overall instructional motivational design construct
3. Individual ARCS components (Attention, Relevance, Confidence, Satisfaction)

## Result

**Analysis of class equivalence based on pretest scores:** A total of 51 students participated in the pretest, consisting of 26 students in the experimental group and 25 students in the control group. The pretest data were analyzed using statistical software (Jamovi Version 2.6.44) to evaluate the preliminary equivalence between groups.

The Shapiro–Wilk test indicates that the motivation data meet the assumption of normality. The obtained W value is 0.961 with a p-value of 0.093, which is greater than the significance level of 0.05. Since the p-value is not statistically significant, the null hypothesis of normality cannot be rejected. Therefore, the data are considered normally distributed, as shown in Table 3.

**Table 3.** Results of the normality test for Pretest motivation

| | W | p |
|---|---|---|
| Motivation | 0.961 | 0.093 |

The Levene's test results indicate that the assumption of homogeneity of variances is satisfied. The obtained F value is 0.177 with a p-value of 0.676, which is greater than the significance level of 0.05. Since the p-value is not statistically significant, the null hypothesis of equal variances cannot be rejected. Therefore, the variances between groups can be considered homogeneous, as shown in Table 4.

**Table 4.** Results of the homogeneity of variances test for the pretest using Levene's test

| | F | df | df2 | p |
|---|---|---|---|---|
| Motivation | 0.177 | 1 | 49 | 0.676 |

The independent samples t-test indicates no significant difference in motivation between the control group and the experimental group. The obtained t value is 0.0037 with 49 degrees of freedom, and the p-value of 0.997 is far greater than the 0.05 significance level. Therefore, the null hypothesis cannot be rejected, and it can be concluded that there is no statistically significant difference in motivation between both groups, as shown in Table 5.

**Table 5.** Results of the T-Test for the pretest data

| | | Statistic | df | p |
|---|---|---|---|---|
| Motivation | Student's t | 0.0037 | 49 | 0.997 |

## Hypothesis testing results

Hypothesis testing was conducted using data from 70 participants enrolled in the third-semester Automata course, consisting of 37 participants in the control group and 33 participants in the experimental group.

## Hypotheses on the multivariate effects on ARCS motivational components

The Shapiro–Wilk test results indicate that the data for the four ARCS components do not meet the assumption of normality (The data were analyzed using the Jamovi statistical software version 2.6.64). The p-values for Attention (p = 0.014), Relevance (p = 0.005), Confidence (p = 0.003), and Satisfaction (p = 0.003) are all below the significance level of 0.05. Since these p-values are statistically significant, the null hypothesis of normality is rejected. Therefore, the distributions of the ARCS component scores deviate from normal, as shown in Table 6. Due to the violation of the normality assumption, PERMANOVA was employed to test the hypotheses on the multivariate effects of the ARCS motivational components.

**Table 6.** The Shapiro-Wilk Test results for the four ARCS components

| | W | P |
|---|---|---|
| Attention | 0.956 | 0.014 |
| Relevance | 0.946 | 0.005 |
| Confidence | 0.944 | 0.003 |
| Satisfaction | 0.944 | 0.003 |

Permanova analysis was performed using the R statistical programming environment (version 2025.05.1). PERMANOVA revealed significant differences in the ARCS motivational profiles between the experimental and control groups using both Euclidean distance ($F = 6.11$, $p = 0.016$, $R^2 = 0.082$), as shown in Table 7, and Bray–Curtis distance ($F = 5.83$, $p = 0.015$, $R^2 = 0.079$), as shown in Table 8. An $R^2$ value of approximately 8% indicates a small-to-moderate contribution of instructional treatment to the variance in students' motivation.

**Table 7.** Permanova using Euclidean distance

| Source | Df | Sum of Squares | $R^2$ | F | p-value |
|---|---|---|---|---|---|
| Model | 1 | 38.98 | 0.08248 | 6.1125 | 0.016* |
| Residual | 68 | 433.6 | 0.91752 | — | — |
| Total | 69 | 472.58 | 1 | — | — |

**Table 8.** Permanova using Bray–Curtis distance

| Source | Df | Sum of Squares | $R^2$ | F | p-value |
|---|---|---|---|---|---|
| Model | 1 | 0.12056 | 0.07894 | 5.8283 | 0.015* |
| Residual | 68 | 1.4066 | 0.92106 | — | — |
| Total | 69 | 1.52716 | 1 | — | — |

## Hypothesis of overall instructional motivation

The experimental group has a higher ARCS motivation score (M = 5.43, SD = 1.02) than the control group (M = 4.69, SD = 1.40). The higher median value in the experimental group also supports this tendency, indicating stronger instructional motivation among students receiving the extended flipped classroom with H5P, as shown

in Table 9.

**Table 9.** Descriptive statistics of students' instructional motivational design

| | Group | N | Mean | Med | SD | SE |
|---|---|---|---|---|---|---|
| ARCS | CONTROL | 37 | 4.69 | 5 | 1.4 | 0.23 |
| | EXPERIMENTAL | 33 | 5.43 | 5.65 | 1.02 | 0.178 |

the Shapiro–Wilk test indicates that the ARCS data do not meet the normality assumption (W = 0.942, p = 0.003). Since the p-value is below 0.05, the null hypothesis of normality is rejected, as shown in Table 10.

**Table 10.** Normality test of ARCS posttest scores

| | W | p |
|---|---|---|
| ARCS | 0.942 | 0.003 |

The Levene's test indicates that the assumption of equal variances is satisfied (F = 2.04, p = 0.158), since the p-value is greater than 0.05. Therefore, the variances between groups can be considered homogeneous, as shown in Table 11.

**Table 11.** Homogeneity test of ARCS posttest scores

| | F | df | df2 | p |
|---|---|---|---|---|
| ARCS | 2.04 | 1 | 68 | 0.158 |

The Mann–Whitney U test indicates a statistically significant difference in ARCS motivation scores between the control and experimental groups (U = 429, p = 0.033). Since the p-value is below 0.05, the null hypothesis is rejected, confirming that the experimental group demonstrates higher motivation than the control group, as shown in Table 12.

**Table 12.** Results of the Mann-Whitney U Test for the ARCS posttest data

| | | Statistic | p |
|---|---|---|---|
| ARCS | Mann-Whitney U | 429 | 0.033 |

**Hypotheses on the effects on individual ARCS components:** Based on the descriptive analysis, the overall results of the four Individual ARCS Components indicate that the experimental group obtained higher scores in Attention, Relevance, Confidence, and Satisfaction. The normality test results also showed that the data for the four Individual ARCS Components were not normally distributed; therefore, the hypothesis testing for these components was conducted using the Mann-Whitney U test.

The Mann–Whitney U test results indicate significant differences in all ARCS components between the control and experimental groups. The differences are significant for Attention (U = 440, p = 0.044), Relevance (U = 428, p = 0.032), Confidence (U = 420, p = 0.025), and Satisfaction (U = 441, p = 0.046), with all p-values below 0.05. These findings confirm that the experimental group demonstrates significantly higher motivational levels across all ARCS dimensions, as shown in Table 13.

**Table 13.** Results of the Mann-Whitney U Test for individual ARCS components

| | | Statistic | p |
|---|---|---|---|
| Attention | Mann-Whitney U | 440 | 0.044 |
| Relevance | Mann-Whitney U | 428 | 0.032 |
| Confidence | Mann-Whitney U | 420 | 0.025 |
| Satisfaction | Mann-Whitney U | 441 | 0.046 |

## Discussion

As shown in Figure 3, the PCoA visualization demonstrates distinct multivariate motivational profiles between the Extended Flipped Classroom with H5P integration group and the control group.

Although some overlap exists, the separation of group centroids and the more compact distribution of the experimental group indicate a more structured and consistent motivational pattern among students experiencing the HTML5 Package-integrated flipped learning environment. Supported by the PERMANOVA results ($p < .05$), this visualization confirms a significant multivariate effect on the combined ARCS motivational components, aligning with the study's hypothesis and reinforcing the claim that the Extended Flipped Classroom model effectively enhances instructional motivational design among Informatics students at Universitas Wijaya Kusuma Surabaya.

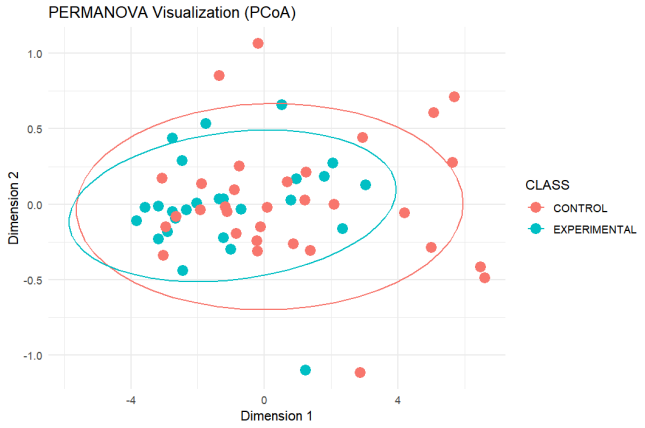


**Figure 2.** The PCoA visualization of Multivariate effects on ARCS motivational components

The experimental group demonstrates higher ARCS motivation scores than the control group, with a higher median score (5.7 vs. 5.0) and a more concentrated distribution, whereas the control group shows a wider spread with several lower outliers. These patterns visually support the statistical findings that the experimental group achieved stronger instructional motivation, as shown in Figure 3.


**Figure 3.** Boxplot of ARCS statistical analysis

The Raincloud plots in Figure 4 show that the Extended Flipped Classroom with HTML5 Package integration has a significant positive effect on each individual ARCS motivational component. Mann–Whitney results indicate higher scores in the experimental group for Attention (p = 0.044), Relevance (p = 0.032), Confidence (p = 0.025), and Satisfaction (p = 0.046), reflecting stronger and more consistent motivational responses. These findings confirm the hypothesis and reinforce that the Extended Flipped Classroom model effectively enhances instructional motivational design among Informatics students at Universitas Wijaya Kusuma Surabaya.

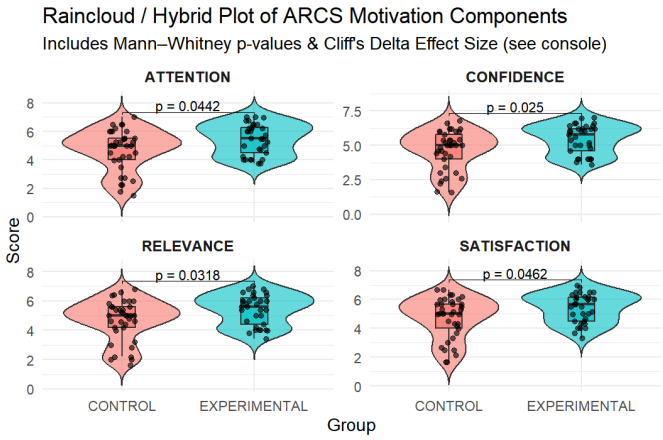


**Figure 4**. Raincloud plots of individual ARCS components under extended flipped classroom with HTML5 integration

Overall, the three visualizations (PCoA, boxplots, and Raincloud plots) consistently demonstrate that the Extended Flipped Classroom with HTML5 Package (H5P) integration in Moodle produces a significant positive impact on students' learning motivation. The PCoA plot shows a clear difference in multivariate motivational profiles between the experimental and control groups, while the boxplots and Raincloud plots confirm that all four ARCS components (Attention, Relevance, Confidence, and Satisfaction) individually exhibit higher scores and more stable distributions in the experimental group. These findings strongly support that the Extended Flipped Classroom model effectively enhances instructional motivational design among Informatics students at Universitas Wijaya Kusuma Surabaya.

In terms of Attention, the extended flipped classroom supported by the HTML5 package successfully captured and sustained students' engagement. The availability of pre-class materials with reflective prompts encouraged students to actively process content before entering the classroom, leading to heightened focus during learning activities.

Regarding Relevance, the integration of interactive

videos that contextualized automata concepts with real-world applications enabled students to perceive the material as meaningful and applicable to their academic and future professional contexts. This alignment between instructional content and students' academic goals strengthened perceived value toward learning.

For Confidence, the structured learning flow across pre-class, in-class, and after-class stages, combined with step-by-step challenges and immediate feedback, helped students develop self-assurance in understanding and applying automata concepts. This gradual competence-building process contributed to students' belief that they were capable of successfully completing assigned tasks.

Finally, in terms of Satisfaction, the requirement for students to demonstrate successful task completion through project-based outcomes fostered a sense of accomplishment. This positive learning experience not only generated emotional satisfaction but also motivated students to repeat and sustain similar productive learning behaviors.

## Conclusion

This study examined the impact of the Extended Flipped Classroom with HTML5 Package (H5P) integration in Moodle on instructional motivational design among Informatics students, using the ARCS framework as the analytical lens. The findings consistently demonstrate that the intervention significantly enhances students' instructional motivation. Multivariate analysis using PERMANOVA confirmed significant differences in motivational profiles between the experimental and control groups, indicating that the intervention influenced the combined ARCS components. Furthermore, univariate analyses supported these results, showing that students in the experimental class achieved significantly higher levels of Attention, Relevance, Confidence, and Satisfaction compared with students in the control class.

Descriptive results strengthened this conclusion, with the experimental group demonstrating higher median scores and a more stable distribution of motivation levels. Visual analyses through PCoA plots, boxplots, and raincloud plots further illustrated clearer motivational advantages among students exposed to the Extended Flipped Classroom model. These findings indicate that the structured integration of H5P-based interactive content across pre-class, in-class, and after-class learning phases effectively supports motivational design elements, fostering sustained engagement, perceived relevance, confidence building, and satisfaction with learning experiences.

Overall, this study provides empirical evidence that the Extended Flipped Classroom with HTML5 Package integration in Moodle is an effective instructional strategy for strengthening motivational design in Informatics education. Practically, the findings suggest that educators should not only adopt flipped classroom approaches but also incorporate motivational design principles explicitly through interactive and meaningful learning activities. Future research may extend this work by examining long-term motivational sustainability, exploring additional cognitive and performance outcomes, and applying the model across different disciplines and institutional contexts.

## References

Abidaturrosyidah, A., Nurdiyanti, N., Jumadi, J., Aldila, F. T., & Ulfa, S. M. (2024). Empowering Students' Creative At The Utilization of Moodle-H5P with Flipped Classroom in Global Warming Learning to Enhance Students' Creative Attitudes. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, *10*(2), 261–272. https://doi.org/10.21009/1.10205

Afjar, A. M., Musri, & Syukri, M. (2020). Attention, relevance, confidence, satisfaction (ARCS) model on students' motivation and learning outcomes in learning physics. *Journal of Physics: Conference Series*, *1460*(1), 012119. https://doi.org/10.1088/1742-6596/1460/1/012119

Baig, M. I., & Yadegaridehkordi, E. (2023). Flipped classroom in higher education: A systematic literature review and research challenges. *International Journal of Educational Technology in Higher Education*, *20*(1), 61.

https://doi.org/10.1186/s41239-023-00430-5

Cook, D. A., & Pankratz, V. S. (2024). Validation of the Instructional Materials Motivation Survey among Medicine Resident Physicians. *MedEdPublish*, *14*, 58. https://doi.org/10.12688/mep.20408.1

Dan, L., & Mohamed, H. B. (2024). A bibliometric review of flipped classroom approaches for enhanced students' language learning. *Contemporary Educational Technology*, *16*(4), ep526. https://doi.org/10.30935/cedtech/15012

Fang, X., Ng, D. T. K., Leung, J. K. L., & Xu, H. (2024). The applications of the ARCS model in instructional design, theoretical framework, and measurement tool: A systematic review of empirical studies. *Interactive Learning Environments*, *32*(10), 5919–5946. https://doi.org/10.1080/10494820.2023.2240867

Faro, M. H., Gutu, T. S., & Hunde, A. B. (2024). Improving student engagement with a flipped classroom instruction model in Ethiopian higher education institutions: The case of Mattu University. *PLOS ONE*, *19*(10), e0307382. https://doi.org/10.1371/journal.pone.0307382

Huff, T., & Tseng, D. C. Y. (2025). Active Learning in Open Digital Textbooks: Designing for Learner Engagement and Motivation using H5P. *TechTrends*. https://doi.org/10.1007/s11528-025-01144-3

Jacob, T., & Centofanti, S. (2024). Effectiveness of H5P

Lin, Y., Xiu, X., Lin, J., Chen, Z., Zheng, C. X., Pan, X., Lin, L., & Yan, J. (2023). Application of Team-Based Flipped Classroom and Traditional Learning on the Antenatal Education Center Course. *Advances in Medical Education and Practice*, *Volume 14*, 1379–1390. https://doi.org/10.2147/AMEP.S429806

Mei, Q., Chan, N. N., Gill, R. S., Subramaniam, N., Motevalli, S., & Ang, C.-S. (2025). Impact of attention, relevance, confidence, satisfaction (ARCS) model on teaching effectiveness in higher education: A systematic review. *Discover Education*, *4*(1), 252.

in improving student learning outcomes in an online tertiary education setting. *Journal of Computing in Higher Education*, *36*(2), 469–485. https://doi.org/10.1007/s12528-023-09361-6

Keedle, H., Young, K., Arundell, F., & Burns, E. (2024). Midwifery student engagement with digital interactive books: A cross sectional survey. *Women and Birth*, *37*(6), 101826. https://doi.org/10.1016/j.wombi.2024.101826

Keller, J. M. (1987). Development and use of the ARCS model of instructional design. *Journal of Instructional Development*, *10*(3), 2–10. https://doi.org/10.1007/bf02905780

Ki, Y. P. (2025). Enhancing Student Engagement And Learning Outcomes In Higher Education Using H5p Interactive Learning Tools: A Systematic Literature Review. *International Journal of Modern Education*, *7*(24), 969–990. https://doi.org/10.35631/IJMOE.724069

Lee, J. S., & Son, H. K. (2024). The effects of problem-based learning integrated with the nursing process on clinical reasoning, communication skills attitude and nursing process competency among nursing students: A quasi-experimental study. *Nurse Education in Practice*, *81*, 104131. https://doi.org/10.1016/j.nepr.2024.104131

Abbas, M., Khan, T. I., & Jam, F. A. (2025). Avoid Excessive Usage: Examining the Motivations and Outcomes of Generative Artificial Intelligence Usage among Students. Journal of Academic Ethics, 1-20.

https://doi.org/10.1007/s44217-025-00674-5

Mutawa, A. M., Al Muttawa, J. A. K., & Sruthi, S. (2023). The Effectiveness of Using H5P for Undergraduate Students in the Asynchronous Distance Learning Environment. *Applied Sciences*, *13*(8), 4983. https://doi.org/10.3390/app13084983

Rahadiani, P., Kekalih, A., Soemantri, D., & Krisnamurti, D. G. B. (2024). Exploring HTML5 Package Interactive Content in Supporting Learning Through Self-Paced Massive Open Online Courses on Healthy Aging: Mixed Methods Study. *JMIR Medical*

*Education*, *10*, e45468. https://doi.org/10.2196/45468

Rahmi, U., Ramadhani Fajri, B., & Azrul, A. (2024). Effectiveness of Interactive Content with H5P for Moodle-Learning Management System in Blended Learning. *Journal of Learning for Development*, *11*(1), 66–81. https://doi.org/10.56059/jl4d.v11i1.1135

Srimaryani, S., Yuliyanto, R., & Milenia Ariyati, I. (2023). ARCS Learning Model in Offline and Online Learning: A Narrative Literature Review. *Economic Education and Entrepreneurship Journal*, *6*(2), 233–243. https://doi.org/10.23960/E3J/v6i2.233-243

Sung, J., & Huang, W. (2022). Motivational Design for Inclusive Digital Learning Innovation: A Systematic Literature Review. *The Journal of Applied Instructional Design*. https://doi.org/10.59668/377.8287

Wehling, J., Volkenstein, S., Dazert, S., Wrobel, C., Van Ackeren, K., Johannsen, K., & Dombrowski, T. (2021). Fast-track flipping: Flipped classroom framework development with open-source H5P interactive tools. *BMC Medical Education*, *21*(1), 351. https://doi.org/10.1186/s12909-021-02784-8

Zhou, Q., & Zhang, H. (2025). Flipped Classroom Teaching and ARCS Motivation Model: Impact on College Students' Deep Learning. *Education Sciences*, *15*(4), 517. https://doi.org/10.3390/educsci15040517