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THE CONTRIBUTION OF MOTIVATION COMPONENTS TOWARDS STUDENTS' CRITICAL THINKING SKILLS IN BIOLOGY LEARNING USING AUGMENTED REALITY

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Abstract

Purpose of the study: The purpose of this research is to reveal the contribution of motivation components (attention, relevance, confidence, and satisfaction) towards critical thinking skills in biology learning.

Methodology: There were 129 equal student samples of Class X of Senior High School based on an equality test and randomly selected. Students' learning motivation was measured using a questionnaire adapted from the ARCS model. The critical thinking skills were measured using an essay test and scored based on a critical thinking skill rubrics. Data analyzed uses multiple regression analysis to determine the contribution of motivation components towards critical thinking skills.

Main Findings: This result shows that teachers have a central role and irreplaceable in learning. The findings also indicate that the confidence and satisfaction components have the most stable contribution towards critical thinking skills in the three different learnings.

Applications of this study: The results of the research can be adopted by teachers to improve attention, relevance, confidence, and satisfaction in the learning process. Research results can also help teachers to take students' attention in learning through the implementation of learning models and augmented reality.

Novelty/Originality of this study: a) There are no studies that examine the contribution of attention, relevance, confidence, and satisfaction to critical thinking skills in Indonesia. b) The most stable contribution of attention, relevance, confidence, and satisfaction to critical thinking skills in different learnings is identified.

Keywords: *Augmented Reality, Biology Learning, Learning Model, Motivation Component Contribution, Students' Critical Thinking Skills, Teacher Central Role.*

INTRODUCTION

Motivation has a central role in influencing various aspects of learning (Hamjah et al., 2011). Motivation is an element that influences students to have self-drive and aspirations (Hamjah et al., 2011). Motivation refers to what you want, what you will do, and your commitment to do it (Keller, 2010). Motivation relates to how individuals conceptualize their goals, carry out activities, and maintain these activities to achieve the goals and evaluate their performance after the goals are accomplished (Anderman & Gray, 2015).

Critical thinking skills are also a major goal in learning. Partnership for 21st Century Skills [P21] (2009) stated that students should have critical thinking skills. Critical thinking skills are rational thinking processes and focus on what decisions to be believed and must be done (Ennis, 2011). Critical thinking is intellectual processes related to concept formation and decision making through algorithmic analysis, synthesis, and evaluation (Walker & Finney, 1999).

The implementation of learning models is the potential to increase students' motivation and critical thinking skills, one of which is the Think, Pair, Share (TPS) learning model. According to (Bamiro, 2015), thinking development and constructs can be improved through the implementation of TPS. The integration of technology in any learning process is also the potential to increase students' learning motivation, one of which is augmented reality (AR). Through the AR, students will interact with information in the form of 3D objects and learn naturally. The students will be able to see the real world with virtual objects generated by computers (Martín-Gutiérrez et al., 2015; Mehta et al., 2016).

The studies on the correlation between motivation and critical thinking skills as a learning output have also been carried out. The research by Roberts and Dyer (2005), Valenzuela et al. (2011) using the Motivation Strategies for Learning Questionnaire (MSLQ), and Semerci (2011) showed that motivation had a significant correlation with critical thinking skills. According to Valenzuela et al. (2011), the main factor for activating students' critical thinking skills is motivation.

Those studies above, the simultaneous contribution of motivation components towards critical thinking skills, had not revealed. Seeing the potential of TPS and AR models in increasing students' motivation and critical thinking skills, this research attempts to integrate AR into the stages of TPS learning. This integration is expected to optimize and to increase

students' motivation and critical thinking skills.

This research aims at revealing the simultaneous contribution of motivation components (attention, relevance, confidence, and satisfaction) towards critical thinking skills, viewed from multiple correlations in various learnings, including the TPS learning model, TPS integrated with AR and conventional learning. By multiple regression analysis, the simultaneous contribution of all motivational components to critical thinking skills can be revealed in each learning; the effective contributions related to attention, relevance, confidence, and satisfaction can also be expressed. The results of this research are important to create a more effective learning environment and to provide information for educators to pay more emphasis to attention, relevance, confidence, and satisfaction aspects of learning motivation as an important part of activating students' critical thinking skills.

LITERATURE REVIEW

Motivation

Motivation directs students' attitudes toward the learning process (Afzal et al., 2010). Motivation has a significant contribution to academic achievement and also important as a result (Ames, 1990). Keller (2010) identified four components of motivation, namely attention, relevance, confidence, and satisfaction. Attention is the process of how to get and maintain attention on learning. Relevance is related to meeting the needs of students to produce positive attitudes in learning. Confidence is related to how to build trust for students' success. Satisfaction is an attempt to raise satisfaction with learning. Satisfaction is related to satisfaction in the learning process.

Attention plays an important role in the ability to prepare and to maintain alertness to process signals with high priority (Posner & Petersen, 1990). Attention is also a mediator of the relationship between interest and learning (Dai & Sternberg, 2004). Maintaining and arousing the attention and curiosity of students is very important during the learning process (Gopalan et al., 2017). Relevance is related to more relevant learning content, so it will make students more motivated in learning (Frymier & Shulman, 1995). Frymier and Shulman (1995) stated that relevance was related to learning content that was more relevant to the students. Relevance can be raised through the use of language and examples that are close to the student environment (Keller, 2010). Confidence enables someone to have the ability to do and to be ready to do it (Sander & Sanders, 2006). Shaukat and Bashir (2015) stated that confidence had an important role in student learning. The students with a higher level of confidence are shown to have higher achievements. Frymier (1994) stated that teacher closeness could have a positive effect on students' motivation because it helped to build their self-confidence. Satisfaction is the impact of the learning process, and it is related to the intention of continuing learning (Wu et al., 2015). According to Topala and Tomozii (2014), learning satisfaction is an attitude towards the environment and learning conditions, learning activities, learning outcomes, and peer relationships in learning. Frymier (1994) stated that the teacher closeness with the students could have an impact on increasing students' satisfaction in learning. Topala and Tomozii (2014) stated that satisfaction was strongly influenced by cultural aspects, while internal factors strongly influenced confidence.

Critical Thinking Skills

The basic characteristic of humans is the ability to think, one of which is the ability to think critically. Critical thinking is a skill for interpreting, evaluating, and communicating observations (Wang & Zheng, 2016). Ennis (1996) proposed six basic elements of critical thinking, namely FRISCO. F (Focus) is the process of focusing issues on making a trusted decision. R (Reason) is related to an understanding of reasons to support or reject based on relevant situations and facts. I (Inference) is a skill to draw conclusions that make sense. S (Situation) is an understanding of the situation to help clarify the problem. The meaning of key terms and relevant supporting parts are thoroughly understood. C (Clarity) is related to explaining the terms used, and O (Overview), the decisions taken are thoroughly reviewed and examined.

Think Pair Share

According to Bamiro (2015), TPS has three-stage, namely, (a) Think, starting with questions or issues raised by the teacher related to the subject matter. Students are allowed to think about the issue, (b) Pair, students' pair up and discuss the issues raised and see different points of view, (c) Share, group pairs then share what they discussed. Shih and Reynolds (2015) stated that the TPS stage allowed students to think of a particular topic, pair with colleagues to discuss responses to issues, then synthesize and share ideas with groups or classes.

There have been many researchers reporting that the implementation of TPS models in a learning process can improve motivation and critical thinking skills. Shih and Reynolds (2015) said that TPS could increase students' motivation. The results of the study by Corebima (2016) showed that the implementation of TPS could improve students' critical thinking skills. The syntax of TPS has an emphasis on students' thinking ability, pair-discussion, then the results of the discussion are shared with the class members. According to Owens and Tanner (2017), students have the confidence to complete activities with peers who support one another at the Pair and Share stage.

Augmented Reality in Learning

According to Azuma (1997), AR is a technology that integrates the real world and the virtual world, having interactive characteristics in real-time, and registered in 3D. Some studies showed that the use of AR increases students' enthusiasm and motivation in learning (Ozdamli & Hursen, 2017; Sampaio & Almeida, 2018). Sampaio and Almeida (2018) stated that the use of AR in learning had a significant positive effect on students'. The students have positive attitudes towards learning in AR learning. Cheng (2017) mentioned that AR could attract students' attention, and the students felt satisfied learning with the use of the AR system in learning. Khan et al. (2019) stated that AR could improve students' attention, relevance, confidence, and satisfaction.

AR can also empower students' critical thinking skills (Carlson & Gagnon, 2016). AR media provides real opportunities for students' critical thinking skills development because AR can improve students' reflective abilities (Ozdamli & Hursen, 2017). Cheng (2017) stated that AR could reduce students' cognitive load. In contrast, Raja and Nagasubramani (2018) stated that the use of technology in learning caused students to lose their focus. According to Olaore (2014), the students are more interested in AR media than subject content.

METHODOLOGY

Research design

This research is a correlational study. This research aims at revealing the contribution of attention, relevance, confidence, and satisfaction towards critical thinking skills.

Population and Sample

The population of this research was the class X students of State Senior High Schools with a total sample of 129 students. The samples were selected using a random sampling technique. The samples consist of three classes, namely conventional class, TPS class, and TPS integrated with AR class (TPSAR). All three classes have passed an equality test.

Research Procedure

The learning process was carried out for one semester using three different classes. The first class was conventional learning; the teacher's role in this conventional learning was more dominant because the teacher conveyed the teaching material using the lecturing method. The second class used the TPS learning model with the learning stages of 1) Thinking 2) Pairing, and 3) Sharing. The third class used the TPS learning model, which was supported by Augmented Reality during the learning process.

All three classes were given essay tests at the beginning and end of learning to measure critical thinking skills. The questionnaire was also given at the beginning and the end of learning to all research samples to obtain information related to students' motivation.

Research Instruments

Students' learning motivation was measured using a questionnaire adapted from the ARCS model (Attention, Relevance, Confidence, and Satisfaction). The questionnaire consisted of 48 question items and used a Likert scale of 5 points. The students' critical thinking skills were measured using an essay test. The students' answer was then measured using a critical thinking skill rubric developed by Zubaidah et al. (2018) modified from Finken and Ennis (1993). Before used, the research instruments had been validated using expert validation and empirical validation.

Data Analysis

The data in this research were analyzed using multiple linear regression analysis to reveal the contribution of each component of motivation towards students' critical thinking skills. Before the data analysis was performed, the normality and the homogeneity of the data had been initially tested.

RESULTS/FINDINGS

TPSAR Learning

The summary of the correlation regression analysis between the motivation components towards students' critical thinking skills related to the implementation of the TPS integrated with AR is presented in Table 1 to Table 4. Table 1 shows that there is a correlation between attention, relevance, confidence, satisfaction, and students' critical thinking skills at the implementation of TPS integrated with AR. The B value of the attention, relevance, confidence, and satisfaction predictors is presented in Table 2, with a constant value of 26,830. The multiple regression equation was $y = 26.830 + 0.351X1 + 0.315X2 + 0.202\ X3 – 0.244X4$.

The simultaneous contribution of the motivation components towards students' critical thinking skills is 33.8% (Table 3). This result shows that the motivation components have a simultaneous contribution of 33.8% towards critical thinking skills, and the remaining 66.2% is the contribution of other factors that are not detected in this research. The

contribution of each component of motivation in TPSAR learning can be seen in Table 4. Based on the analysis results presented in Table 4, it is known that the effective contributions of attention, relevance, confidence, and satisfaction are 10.44%, 11.29%, 7.20%, and 4.87%, respectively.

Table 1: The Summary of ANOVA on the Correlation between Attention, Relevance, Confidence, Satisfaction, and Critical Thinking Skills

ANOVA[a]						
Model		**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
TPSAR	Regression	225.288	4	56.322	7.290	.000[b]
	Residual	440.369	57	7.726		
	Total	665.657	61			

Source: Data analysis results of this research

Table 2: The Regression Coefficient of the Correlation between Attention, Relevance, Confidence, Satisfaction, and Critical Thinking Skills

Coefficients[a]						
		Unstandardized Coefficients		**Standardized Coefficients**		
Model		**B**	**Std. Error**	**Beta**	**t**	**Sig.**
TPSAR	(Constant)	26.830	10.786		2.488	.016
	Attention	.351	.167	,313	2.100	.040
	Relevance	.315	.147	.325	2.144	.036
	Confidence	.202	.156	.213	1.292	.202
	Satisfaction	-.244	.165	-.232	-1.479	.145

Source: Data analysis results of this research

Table 3: The Summary of the Results of Multiple Regression between Attention, Relevance, Confidence, Satisfaction, and Students' Critical Thinking Skills

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
TPSAR	.582[a]	.338	.292	2.77953

Source: Data analysis results of this research

Table 4: The Contribution of Attention, Relevance, Confidence, and Satisfaction towards Students' Critical Thinking Skills

Variable	**RC (%)**	**EC (%)**
X1 (Attention) - Y (Critical Thinking Skills)	30.89	10.44
X2 (Relevance) - Y (Critical Thinking Skills)	33.8	11.29
X3 (Confidence) - Y (Critical Thinking Skills)	21.33	7.20
X4 (Satisfaction) - Y (Critical Thinking Skills)	14.40	4.87
Total	100	33.8

Source: Data analysis results of this research

TPS Learning

The summary of the correlation regression analysis between the motivation components and students' critical thinking skills related to the implementation of the TPS learning strategy is presented in Table 5 to Table 8. Table 5 shows that there is a correlation between attention, relevance, confidence, satisfaction, and students' critical thinking skills at the implementation of the TPS learning strategy. The B values of the attention, relevance, confidence, and satisfaction predictors are presented in Table 6, with a constant of 3.656. The multiple regression equation is Y = 3.656 + 0.739X1 - 0.300X2 + 0.648 X3 – 0.211X4.

The simultaneous contribution of the motivation components towards students' critical thinking skills is 47.6% (Table 7.). This result shows that the motivation components have a simultaneous contribution of 47.6% towards students' critical thinking skills, and the remaining 52.4% is the contribution of other factors that are not detected in this research. The contribution of each component of motivation towards students' critical thinking skills at the implementation of the TPS learning strategy can be seen in Table 8. Based on the analysis results presented in Table 8, it is known that the effective contributions of attention, relevance, confidence, and satisfaction are 18.63%, 7.76%, 17.50%, and 3.72%, respectively.

Table 5: The Summary of ANOVA on the Correlation between Attention, Relevance, Confidence, Satisfaction, and Students' Critical Thinking Skills

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	Sig.
TPS	Regression	208.314	4	52.079	6.818	.000[b]
	Residual	229.166	30	7.639		
	Total	437.480	34			

Source: Data analysis results of this research

Table 6: The Regression Coefficient of the Correlation between Attention, Relevance, Confidence, Satisfaction, and Students' Critical Thinking Skills

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std.Error	Beta		
TPS	(Constant)	3.656	12.967		.282	.780
	Attention	.739	.282	.614	2.616	.014
	Relevance	-.300	.308	-.277	-.975	.337
	Confidence	.648	.258	.584	2.512	.018
	Satisfaction	-.211	.176	-.216	-1.194	.242

Source: Data analysis results of this research

Table 7: The Summary of Multiple Regression between Attention, Relevance, Confidence, Satisfaction, and Students' Critical Thinking Skills

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
TPS	.690[a]	.476	.406	2.76385

Source: Data analysis results of this research

Table 8: The Contribution of Attention, Relevance, Confidence, and Satisfaction towards Students' Critical Thinking Skills

Variable	RC (%)	EC (%)
X1 (Attention) - Y (Critical Thinking Skills)	39.14	18.63
X2 (Relevance) - Y (Critical Thinking Skills)	16.28	7.76
X3 (Confidence) - Y (Critical Thinking Skills)	36.75	17.50
X4 (Satisfaction) - Y (Critical Thinking Skills)	7.78	3.72
Total	100	47.6

Source: Data analysis results of this research

Conventional Learning

The summary of the correlation regression analysis between the motivation components and students' critical thinking skills related to the implementation of conventional learning is presented in Table 9 to Table 12. Table 9 shows that there is a correlation between attention, relevance, confidence, satisfaction, and students' critical thinking skills in conventional learning. The B values of the attention, relevance, confidence, and satisfaction predictors are presented in Table 10, with a constant value of -25.891. The multiple regression equation is Y = -25.891 + 0.201X1 + 565X2 + 0.314X3 – 0.224X4.

The simultaneous contribution of the motivation components towards students' critical thinking skills is 55.8% (Table 11.), and the remaining 44.2% is the contribution of other factors that are not detected in this research. The contribution of each motivation component in conventional learning can be seen in Table 12. Based on the analysis results presented in Table 12, it is known that the effective contributions of attention, relevance, confidence, and satisfaction were 3.91%, 28.01%, 16.64%, and 7.24%, respectively.

Table 9: The Summary of ANOVA on the Correlation between the Attention, Relevance, Confidence, Satisfaction, and Students' Critical Thinking Skills

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Conventional	Regression	335.296	4	83.824	8.511	.000[b]
	Residual	265.912	27	9.849		
	Total	601.209	31			

Source: Data analysis results of this research

Table 10: The Regression Coefficients of the Correlation between Attention, Relevance, Confidence, Satisfaction, and Students' Critical Thinking Skills

Coefficients[a]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std.Error**	**Beta**		
Conventional	(Constant)	-25.891	19.548		-1.324	.196
	Attention	.207	.262	.111	.790	.436
	Relevance	.565	.184	.449	3.070	.005
	Confidence	.314	.163	.304	1.921	.065
	Satisfaction	.224	.262	.138	.854	.401

Source: Data analysis results of this research

Table 11: The Summary of multiple Regression between Attention, Relevance, Confidence, Satisfaction, and Students' Critical Thinking Skills

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
Conventional	.747[a]	.558	.492	3.13825

Source: Data analysis results of this research

Table 12: The Contribution of Attention, Relevance, Confidence, Satisfaction towards Students' Critical Thinking Skills

Variable	**RC (%)**	**EC (%)**
X1 (Attention) - Y (Critical Thinking Skills)	7.10	3.91
X2 (Relevance) - Y (Critical Thinking Skills)	50.20	28.01
X3 (Confidence) - Y (Critical Thinking Skills)	29.80	16.64
X4 (satisfaction) - Y (Critical Thinking Skills)	12.90	7.24
Total	100	55.8

Source: Data analysis results of this research

DISCUSSION / ANALYSIS

Based on the results of the correlation above, it can be seen that the greatest simultaneous contribution of the attention, relevance, confidence, and satisfaction predictors towards students' critical thinking skills is found in the conventional learning with 55.8% (Table 11). The simultaneous contributions of the predictors towards the students' critical thinking skills in TPS learning and the TPSAR learning are 47.6% and 33.8%, respectively (Tables 3 and 7). This result is caused by the fact that the students are less accustomed to the learning strategies that demand students' independence and involvement in the learning process (Bahri & Corebima, 2015). In the conventional learning, the students seem to be more accustomed to being in the 'comfort zone' by only passively receiving explanations from teachers, which does not demand a lot of authentic assignments as well as does not require their involvement in the learning process (Bahri & Corebima, 2015). These results may indicate that teachers have a central role in learning, which cannot be replaced by anything, including the learning media. From these findings, it seems that teachers are aware of the importance and the central role of their duties as teachers.

Another factor is the socio-cultural factor. Madurese people are known to have cultural exclusivity, especially in their obedience and their submission. Hierarchically, teachers are the second figure after the parents. In the hierarchy, the figures are Buppa', Babbu, Guru, and Rato (Father, Mother, Teacher, and Government Leader). The Madurese people give hierarchical obedience to these main figures in their socio-cultural life (Wiyata & Latief, 2002). This hierarchical compliance cannot be ruled out because it is a necessity to be actualized in their daily practices as a binding normative rule.

The contribution of each motivation component shows that the contributions of the attention predictor towards critical thinking skills in the TPS learning, in the TPSAR learning, and the conventional learning are 18.63%, 10.44%, and 3.91% respectively (Tables 4, 8, and 12). These results indicate that the implementation of learning models can increase the contribution of attention towards students' critical thinking skills.

The attention predictor in conventional learning has the smallest contribution because conventional learning has a monotonous learning process, and the teacher is more dominant. Learning is more focused on the oral narration of the learning material so that the students lose attention in the learning activities. Attention is closely related to the level of students' interest in learning. Krapp (1999) stated that a high level of learning interest would automatically lead to a high level of attention. The results also show that the contribution of attention in TPSAR learning to students' critical thinking is lower than TPS learning. The low contribution of attention in TPSAR learning is caused by the fact that students are more interested in AR media than subject content. These findings in line with the statement Raja and Nagasubramani (2018) stating that students lost their focus on AR learning.

The data in table 4, 8, and 12 show that the highest contribution of the relevance component towards students' critical thinking skills is found in conventional learning, which is 28.01%. The contributions of the relevance component in TPS learning and TPSAR learning are 7.76% and 11.29%, respectively. These findings indicate that teachers in conventional learning can increase the perception of the relevance of the learning content. The teachers in the conventional learning can convey the learning content closer to the students than those in the TPS and TPSAR learnings. It makes the students more motivated in learning. Although the contribution of relevance in conventional learning is the highest, the contribution of attention in conventional learning is the lowest. The teachers' efforts in creating relevant content, but the students pay little attention to the learning activities (Frymier & Shulman, 1995).

The contributions of relevance predictor in the TPS and TPSAR learnings are lower than that in the conventional learning because the students are fixated on the assignments in the student worksheet and the learning contents, which are quite general. According to the National Research Council [NRC] and the Institute of Medicine (2004), learning must be relevant to the socio-culture, background, and personal experience of the students, and it should provide opportunities for students to engage in authentic assignments outside the classrooms.

The contributions of the confidence component in conventional learning, TPS learning, and TPSAR learning are 16.64 %, 17.50%, and 7.20%, respectively. The contribution value of the confidence component in TPSAR learning is the lowest of all, and the highest contribution of the confidence component is found in TPS learning. According to Shaukat and Bashir (2015), the level of confidence is believed to affect the performance caused by the influence on task perception. This is in line with the TPS learning model, which is oriented to work on tasks through student worksheets. In the syntax of the TPS learning model, the students' thinking skills are emphasized through group assignments (Shih & Reynolds, 2015). The habituation in solving problems through tasks is expected to be able to build up students' confidence. In conventional learning, the students' confidence is very likely to be influenced by the closeness factor with the teacher.

The contribution of confidence in TPSAR learning is the lowest one of all because the implementation of AR is a new thing for the students so that they are not a costumed yet. Another important factor to be considered is the amount of time spent on giving instructions for using AR. According to Gavish et al. (2015), the AR user group needed longer training time compared to those who did not use AR.

The contributions of satisfaction component towards the critical thinking skills in conventional learning, TPS learning, and TPSAR learning are 7.24%, 3.72%, and 4.87%, respectively. The highest contribution of the satisfaction component is found in conventional learning. This result is strongly influenced by the proximity factor between teachers and students. According to Suarman (2015), the relationship between teachers and students was a key factor in determining the quality of the learning process in classrooms.

Several research results related to academic satisfaction and academic performance are not always consistent. Dhaqane and Afrah (2016) stated that there was a strong correlation between students' satisfaction and academic performance. In contrast, Blanz (2014) found no correlation between students' satisfaction and students' performance. According to Blanz (2014), learning satisfaction was determined by "non-cognitive" factors.

The findings of this research indicate that confidence and satisfaction predictors have the most stable contribution than the other predictors. The results of this research prove that the contribution of confidence at the implementation of different learning models is not significantly different. However, the satisfaction component has a relatively low contribution. The research by According to Shaukat and Bashir (2015), students intrinsically had strong beliefs or expectations that they would be academically successful.

Based on these findings, improvement efforts related to students' attention in conventional learning need to be done. The teachers should be able to provide a stimulus to gain and maintain students' attention in learning. One way to attract students' attention to learning is through the implementation of TPS learning models and the use of AR media. It can be seen from the fact that the attention component in TPS and TPSAR learning has a higher contribution compared to

conventional learnings in this research. Therefore, it is expected that it can increase the contribution of attention component towards students' critical thinking skills in conventional learning. The findings of this research also show that the highest contribution of relevance towards students' critical thinking skills is found in conventional learning as much as 28.01%. The relevance aspect can be an important point for teachers that needs to be developed in the learning process.

CONCLUSION

The results of this research show that the highest simultaneous contribution of attention, relevance, confidence, and satisfaction predictors towards students' critical thinking skills is found in the conventional learning as much as 55.8%; while the contributions of the predictors in the TPS learning and TPSAR learning are as much as 47.6% and 33.8%, respectively. The results of this research also show that the attention and satisfaction components have the most stable contribution towards students' critical thinking skills at the implementation of different learnings. The finding of this research shows that conventional learning does not necessarily have to be the lowest learning compared to the other learning models. This finding shows that teachers have a central role in the learning process and cannot be replaced by anything, including the learning media. This finding is supported by Carrillo (2012), who stated that ICT was not possible to replace teachers in the learning process. A study by Kolchenko (2018) related to artificial intelligence (AI) also concluded that AI could not replace the teacher's role in the learning process.

LIMITATION AND STUDY FORWARD

The results of this study are limited to biology learning in senior high school. The measurement of motivation uses a questionnaire modified from ARCS. Further research can be carried out at different levels of education, subjects, and implementation of learning models. Measurement of motivation can also be done by using other supporting instruments BESIDES THE QUESTIONNAIRE.

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AUTHORS CONTRIBUTION

The first author contributes to the process of collecting data and interpreting the findings. The second author becomes the corresponding author. The second author also contributed to the literature review and research methods. The third and fourth authors contribute to the readiness of the article review and literature review.

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