



Effects of Interactive Multimedia-Assisted Learning Model and Kinesthetic Talent on Learning Achievement and Collaborative Skills

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ABSTRACT

The quality of learning achievement and collaborative skills of students in soccer courses is still relatively low. One of the main contributing factors is the lack of optimal learning strategies. This condition is reflected in the unsatisfactory achievement of student learning outcomes. This study aimed to analyze the differences in learning achievement and collaborative skills between students receiving problem-based learning models assisted by interactive multimedia and students receiving a conventional learning model. The design of this study followed the experimental design of the non-equivalent post-test only control group design. The sampling technique used in this study was the simple random sampling. This study involved 64 students as samples, including 32 high Kinesthetic talents and 32 low Kinesthetic talents. Each of the 16 samples was given the problem-based learning models assisted by the interactive multimedia treatment and the conventional treatment. The results showed that the students receiving the problem-based learning model assisted by interactive multimedia were better than students receiving the conventional learning model. Based on the results of hypothesis testing and discussion, the selection of learning model and Kinesthetic talent level are essential in achieving the learning outcome and collaborative skills.

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INTRODUCTION

The National Education Association has identified 21st century skills as "The 4Cs" which include critical thinking, creativity, communication, and collaboration (Redhana, 2019). According to Greenstein, one of the skills that students need to master in the learning process is collaborative skills (Redhana, 2019). Collaborative skills refer to the ability to work effectively with others, demonstrate respect for diverse team members, and make collective decisions to achieve shared goals (Redhana, 2019).

Despite the recognized importance of collaboration, the quality of students' learning achievement and collaborative skills in soccer courses remains relatively low. One of the primary contributing factors is the suboptimal implementation of learning strategies and instructional design. This condition is reflected in students' unsatisfactory learning outcomes. Empirical observations indicate that collaborative skills are still insufficiently integrated into higher education curricula, particularly at Universitas Pendidikan Ganesha (Undiksha). Current instructional practices tend to emphasize individual learning rather than structured and meaningful interactions, discussions, and teamwork. As a result, students have limited opportunities to develop collaborative competencies, even though teamwork is a fundamental requirement in soccer to support team cohesion and performance (Dewi & Mailasari, 2020). However, efforts to improve collaborative skills remain insufficient, especially lecturers who hold soccer courses, so that it will impact the low quality of student soccer games both at the regional and national levels.

The low quality of learning achievement and collaborative skills in soccer education cannot be separated from various instructional factors, including learning design and delivery (Nurdyansyah & Widodo, 2015). Limited learning resources, insufficient innovation, and outdated learning materials negatively affect students' learning outcomes (Satyawan et al., 2023). In many cases, lecturers still employ teacher-centered instructional approaches, relying heavily on conventional learning models with minimal integration of learning media (Fathurrohman, 2015). Lecturer-centered learning models tend to be applied with conventional models without being balanced with the use of learning media so that they can drown out interactivity, absorption, and student interest in the subject matter (Siahaan et al., 2022). Consequently, students tend to acquire theoretical knowledge without adequate opportunities for application and direct experience, leading to low learning achievement and underdeveloped collaborative skills (Sumarsono et al., 2019). Conventional learning models are therefore strongly suspected of hindering the development of both learning achievement and collaborative skills (Siahaan et al., 2022).

One of the core principles of higher education curricula is the development of students' abilities to think creatively, act productively, and collaborate effectively. Learning should not be limited to the acquisition of concepts, theories, and facts, but should also emphasize their application in real-life contexts (Sopiansyah & Masrurah, 2022). Thus, the learning material is composed of not only simple things that are memorized, and comprehended, but also complex materials that require analysis, application and synthesis. Quality learning involves not only memorization but also problem-solving through systematic thinking processes carried out collaboratively until meaningful solutions are achieved (Nurdyansyah & Fahyuni, 2016).

Problem-based learning (PBL) has been widely recognized as an effective instructional approach for enhancing students' collaborative skills. However, the integration of PBL with interactive multimedia in sports education remains relatively underexplored. Several studies

have demonstrated that collaboration skills can be effectively fostered through PBL (Dhitasarifa et al., 2023). This aligns with a research results showing that collaboration skills can be taught with a problem-based learning model (Mashud et al., 2022). Another research conducted found that the application of PBL improves collaboration skills (Fitriyani et al., 2019). To support the effective implementation of PBL, interactive multimedia can be utilized to integrate text, graphics, audio, and interactive elements, enabling students not only to observe learning materials but also to actively engage with them. With the use of interactive multimedia, it is expected that there will be changes in the learning process. Electronic-based media as part of technology has many benefits in the learning process, which is used to support the teaching presentation and as a learning resource. In addition, the media is also used as a tool to store and convey messages to students. Media use in the learning process is applied to complement and assist lecturers in delivering material to students (Istiqlal, 2017).

Previous studies have shown that the development and implementation of interactive learning content in soccer education using blended learning strategies are effective in improving learning outcomes (Wijayanti, 2021). Similar findings were reported in the development of interactive learning content for sepak takraw courses, which demonstrated effectiveness in supporting theoretical and practical (Yanottama et al., 2021). In the learning by using ICT-based media will occur interaction between students and media, students with lecturers, and students with other students, so the expected learning objectives will be achieved. Along with the development of technology and the need for relevant learning resources, the media develops into interactive multimedia that is more interesting for students.

In addition to external aspects such as learning models and the use of information and communication technology, internal aspects of students also play an important role. Elements such as aptitude, attitude, interest and learning motivation also influence the development of students' kinesthetic abilities. Kinesthetic talent, which corresponds to bodily-kinesthetic intelligence proposed by Howard Gardner, refers to an individual's ability to use the body effectively for expression and technical performance. In soccer learning, kinesthetic talent is particularly important, as the sport requires motor coordination, agility, speed, and responsiveness to dynamic game situations.

Students with high kinesthetic talent generally demonstrate greater ease in understanding instructions, imitating movements, and mastering basic soccer techniques. They tend to be more active in physical activities and exhibit heightened sensitivity to body movements, both their own and those of others. Therefore, in practice-based learning such as soccer, developing students' kinesthetic potential is one of the key factors in improving learning achievement and collaborative skills. Understanding kinesthetic talent is also important in designing adaptive and fun learning strategies, for example through game-based approaches, match simulations, or the use of visual motion media. Consequently, learning models that accommodate variations in students' kinesthetic talent have the potential to create more effective, engaging, adaptive learning environments, and have a positive impact on the achievement of students' practical skills. Interest in learning can be influenced by the relationship or correlation with the use of technology (Satyawan et al., 2022). The principle of the curriculum in private or independent universities emphasizes that the learning process should be interactive, inspiring, and enjoyable, while providing sufficient opportunities for the development of students' initiative, creativity, talents, interests, and physical and psychological growth. In this context, ability and talent play a crucial role in determining an individual's learning achievement and collaborative skills, as ability reflects a person's potential to perform actions effectively in the future. Research has shown that kinesthetic

talent is positively and significantly related to learning achievement in sports (Artha et al., 2015). This is supported by research results, found that kinesthetic talent has a positive and significant linear relationship with learning achievement (Artha et al., 2015). This shows that higher levels of kinesthetic talent are associated with higher learning achievement, while lower levels correspond to lower achievement.

Several empirical studies further support the role of kinesthetic intelligence in sports performance. Ay et al. (2018) found a significant relationship between kinesthetic-physical intelligence and swimming performance among physical education students. Similarly, Akbar (2021) reported a significant correlation between kinesthetic intelligence and basketball playing skills. These findings indicate that both instructional approaches and individual kinesthetic characteristics play critical roles in optimizing students' learning achievement and collaborative skills. Thus, the interactive multimedia-assisted Problem-Based Learning (PBL) approach, together with students' kinesthetic talent, plays a crucial role in uncovering and developing students' latent abilities and talents.

Given the limited empirical research examining the combined effects of interactive multimedia-assisted PBL and kinesthetic talent in sports education, this study aims to address this gap. The interactive multimedia-assisted learning model is an innovation proven effective in improving the learning process. However, to maximize its benefits, it is important to understand the role of kinesthetic aptitude in this context. The empirical data obtained in this study provide a deeper understanding of how learners with different types of kinesthetic talent respond to and utilize interactive multimedia learning models. This information can guide educators in designing more inclusive curricula and learning methods and ensuring that every learner can achieve optimal learning achievement and develop the collaborative skills needed in an increasingly complex and connected society. Therefore, this research is highly relevant and has the potential to make a major contribution to improving the education system.

METHODS

This research employed a quasi-experimental design, specifically The Non-Equivalent Posttest Only Control Group Design. This design was selected because the focus of the research was to examine the differences in the final results of learning achievement and collaborative skills between students who were taught using the MPBM model assisted by interactive multimedia and those using the MPK model. This study did not aim to measure learning gain of each group; therefore, the administration of a pretest was considered unnecessary.

In addition, the absence of pretest was intended to avoid the pretest sensitization effects, which could affect learners' response to treatment and interfere with the internal validity of the study. In this context, the posttest was considered sufficient to provide a representative picture of the effect of each learning model on student learning outcomes and collaborative skills. Data on learning achievement and collaborative skills in this study were taken from post-test scores only which were conducted at the end of the study or in other words without taking into account the pre-test scores.

Participants

The population of this study consisted of all first-semester students enrolled in the Physical Education (PE) Department at Universitas Pendidikan Ganesha (Undiksha) during the 2022/2023 academic year. The population comprised five classes (IKI, A, B, C, and D) with a total of 137 students, including 67 male and 70 female students, with an average age ranging from 19 to 20 years.

Due to the organizational structure of the population and the impracticality of randomizing individual participants, sampling was conducted using simple random sampling at the class level. Based on this procedure, Class A and Class B were randomly selected as the experimental groups and were taught using the interactive multimedia–assisted PBL model. Class C and Class D were selected as the control groups and received instruction using a conventional learning model. From each class, students were categorized based on their level of kinesthetic talent. A total of 64 students were selected as research participants, consisting of 32 students with high kinesthetic talent and 32 students with low kinesthetic talent. Each experimental and control group included 16 students from the high kinesthetic talent group and 16 students from the low kinesthetic talent group.

Sampling Procedures

Students were grouped according to their kinesthetic talent based on the scores obtained from the kinesthetic talent test. The test scores were then ranked. The top 30% of students who learned through the interactive multimedia–assisted problem-based learning model were classified as having high kinesthetic talent, while the bottom 30% were classified as having low kinesthetic talent. The same classification procedure was applied to students who learned through the conventional learning model. Accordingly, the top 30% of students in the conventional learning group were categorized as having high kinesthetic talent, and the bottom 30% were categorized as having low kinesthetic talent. Based on the random sampling technique, Class A and Class B were selected as experimental groups and were taught using the interactive multimedia–assisted problem-based learning model, while Class C and Class D were selected as control groups and received instruction using the conventional learning model. From both the experimental and control groups, 16 students from the high kinesthetic talent group and 16 students from the low kinesthetic talent group were selected as research samples. In total, 64 students participated in the study, consisting of 32 students with high kinesthetic talent and 32 students with low kinesthetic talent. Each group of 16 students received instruction either through the interactive multimedia–assisted problem-based learning model or through the conventional learning model.

Materials and Apparatus

This study examined the effects of two independent variables on two dependent variables. The independent variables consisted of a treatment variable and a moderator variable. The treatment variable was the learning model, which comprised two instructional approaches: (1) an interactive multimedia–assisted problem-based learning model (MPBM) and (2) a conventional learning model (MPK). The interactive multimedia–assisted problem-based learning model was implemented in the experimental group, while the conventional learning model was applied in the control group. The moderator variable in this study was kinesthetic talent, which was categorized into two levels: high and low. The dependent variables investigated were students' learning achievement in soccer courses and their collaborative skills.

Interactive multimedia used in this study was developed using Articulate Storyline, an authoring software that enables the creation of dynamic and responsive digital learning content. The developed multimedia included instructional videos, interactive learning materials, and evaluative quizzes designed to support students' active engagement. After the development process was completed, the multimedia was implemented and tested with students as part of the interactive multimedia–assisted problem-based learning model. In practice, the interactive multimedia facilitated students' understanding of the presented problems, supported the exploration of potential solutions, and enabled students to evaluate their understanding individually and through group discussions. This approach not only

enhanced access to visual and interactive learning materials but also encouraged students to think critically, collaborate effectively, and actively participate in the learning process.

Procedures

This study employed three research instruments. One instrument was used to measure students' kinesthetic talent, while the other two instruments were used to measure the dependent variables as direct outcomes of the instructional treatment. The dependent-variable instruments consisted of: (1) a soccer course learning achievement test and (2) a collaborative skills test. Students' kinesthetic talent was measured using the Analysis Kinestetik instrument, a kinesthetic talent test developed by Mike Bryon and translated into Indonesian by Vinaya. Learning achievement in soccer courses was assessed using an expanded multiple-choice test consisting of five answer options. This test was administered to both experimental and control groups to measure students' learning achievement. The scoring criteria for the learning achievement test were based on a rubric with a score range of 0–4, adapted from Santyasa (2004).

Students' collaborative skills were measured using a collaborative skills test designed to assess several dimensions, including contribution, time management, problem solving, teamwork, and inquiry skills. Students were required to provide accurate and comprehensive responses that reflected higher-order thinking processes and divergent thinking.

The development of the soccer course learning achievement test followed several stages: (1) identification of competency standards, (2) identification of basic competencies, (3) identification and formulation of student achievement indicators, (4) construction of a test blueprint, (5) determination of assessment criteria, (6) item writing, (7) expert validation involving two lecturers and a soccer course lecturer, (8) field testing, (9) item analysis, (10) item revision, and (11) finalization of the instrument.

The collaborative skills test was developed using a similar procedure, which included: (1) identification of collaborative skill dimensions, (2) formulation of achievement indicators, (3) construction of a test blueprint, (4) determination of assessment criteria, (5) item writing, (6) expert validation involving two lecturers, (7) field testing, (8) item analysis, (9) item revision, and (10) finalization of the instrument.

Likewise, the kinesthetic talent test was developed through the following stages: (1) identification of kinesthetic talent dimensions, (2) formulation of achievement indicators, (3) construction of a kinesthetic talent test blueprint, (4) determination of assessment criteria, (5) item writing, (6) expert validation involving two lecturers, (7) field testing, (8) item analysis, (9) item revision, and (10) finalization of the instrument.

Data Analysis

Prior to data analysis, the obtained data were examined for normality, homogeneity, and collinearity. The normality test was conducted to ensure that the sample data were drawn from a normally distributed population, thereby allowing valid hypothesis testing. Normality testing was performed for each unit of analysis, across learning model groups and kinesthetic talent groups, using the Kolmogorov–Smirnov and Shapiro–Wilk tests (Khatun, 2021). Homogeneity of variance between groups was tested to determine whether the variances among groups were equal (Zhou et al., 2023). This test was also conducted to ensure that any differences identified in hypothesis testing were attributable to group differences rather than variance inequality (Zhou et al., 2023). In addition, the homogeneity of variance–covariance matrices was examined using Box's Test of Equality of Covariance Matrices (Friendly & Sigal, 2020). Collinearity testing was performed to determine whether a significant correlation existed between the dependent variables. This procedure aimed to ensure that learning achievement and collaborative skills measured distinct constructs rather than the same

underlying aspect. Collinearity was assessed by calculating the correlation coefficient between the scores of the two dependent variables using Pearson's product-moment correlation (Naibaho et al., 2020).

RESULTS

Overall, students who learned through the interactive multimedia-assisted problem-based learning model (MPBM-MI) demonstrated higher learning achievement than those who learned through the conventional learning model (MPK). This pattern was observed across both levels of kinesthetic talent.

In the interactive multimedia-assisted problem-based learning (MPBM-MI) group, learning achievement was categorized as high for 21.88% of students, moderate for 50.00%, and low for 28.12%. In contrast, students in the conventional learning model (MPK) group demonstrated lower achievement levels, with 46.88% categorized as sufficient, 50.00% as low, and 3.12% as very low. Based on kinesthetic talent, learning achievement among students with high kinesthetic talent was classified as high for 18.75%, moderate for 46.87%, and low for 34.38%. Meanwhile, students with low kinesthetic talent showed lower performance, with 3.12% categorized as high, 53.13% as moderate, 40.63% as low, and 3.12% as very low.

The mean learning achievement score for students in the MPBM-MI group ($n = 32$) was within the standard score range of 60–69, which falls into the sufficient category. In comparison, students in the MPK group ($n = 32$) obtained mean scores within the range of 50–59, categorized as low. Further analysis showed that the mean learning achievement score of the MPBM-MI group was 64.47 ($SD = 6.27$), while the MPK group achieved a mean score of 58.97 ($SD = 4.04$). Descriptively, these results indicate that the MPBM-MI model provided a more effective learning environment for achieving higher learning achievement. When examined by kinesthetic talent, students with high kinesthetic talent achieved a mean learning achievement score of 63.03 ($SD = 7.05$), whereas students with low kinesthetic talent obtained a mean score of 60.41 ($SD = 4.25$). These findings suggest that, descriptively, students with high kinesthetic talent demonstrated higher learning achievement than those with low kinesthetic talent. Overall, the mean learning achievement score for all participants ($n = 64$) was 61.72 ($SD = 5.92$), which falls within the sufficient category.

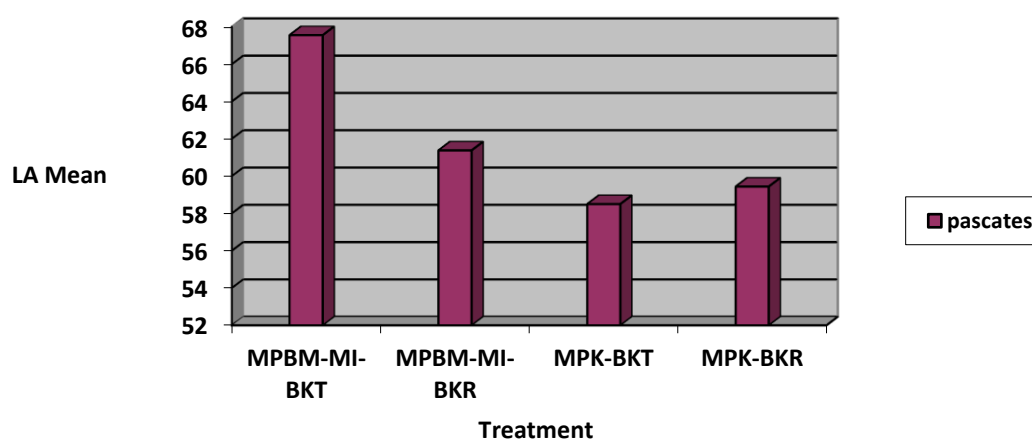


Figure 1. Learning achievement profile graph

Learners who were taught using problem-based learning models assisted by interactive multimedia demonstrated better collaborative skills than those who were taught using conventional learning models. Similarly, students who followed the MPBM-MI model outperformed those who followed the MPK model in achieving collaborative skills in soccer learning, both among students with high and low kinesthetic talent.

In the interactive multimedia-assisted problem-based learning group, students' collaborative skills were classified as high for 6.25% of learners, sufficient for 65.63%, low for 25.00%, and very low for 3.12%. In contrast, the conventional learning model group showed lower collaborative skills, with 43.75% of students categorized as sufficient, 37.50% as low, and 18.75% as very low. Based on kinesthetic talent, collaborative skills among students with high kinesthetic talent were categorized as very low for 12.50%, low for 21.88%, sufficient for 59.37%, and high for 6.25%. Meanwhile, students with low kinesthetic talent demonstrated collaborative skills categorized as very low for 9.37%, low for 40.63%, and sufficient for 50.00%.

The mean collaborative skills score for students in the MPBM-MI group ($n = 32$) fell within the standard score range of 60–69, which corresponds to the sufficient category. In comparison, the MPK group ($n = 32$) achieved mean scores within the range of 50–59, categorized as low. Further analysis revealed that the mean collaborative skills score of the MPBM-MI group was 61.50 ($SD = 6.24$), while the MPK group obtained a mean score of 55.88 ($SD = 5.97$). Descriptively, these findings indicate that the MPBM-MI model provided a more supportive learning environment for the development of students' collaborative skills. When analyzed by kinesthetic talent, students with high kinesthetic talent achieved a mean collaborative skills score of 60.25 ($SD = 7.59$), categorized as sufficient, whereas students with low kinesthetic talent obtained a mean score of 57.13 ($SD = 5.30$), categorized as low. Overall, students with high kinesthetic talent demonstrated descriptively higher collaborative skills than those with low kinesthetic talent. The overall mean collaborative skills score for all participants ($n = 64$) was 58.69 ($SD = 6.69$), which falls within the low category.

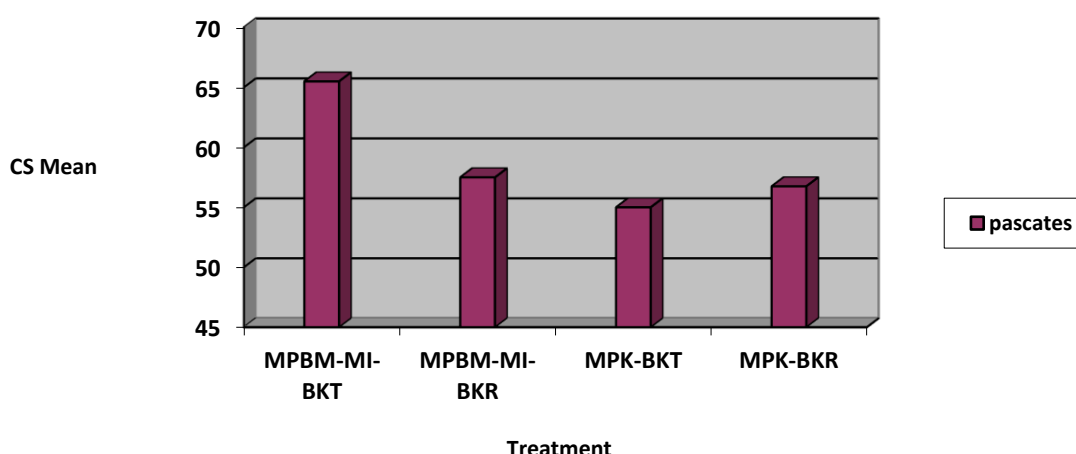


Figure 2. Collaborative skills profile graph

The units of analysis for learning achievement data were normally distributed, as indicated by Kolmogorov–Smirnov and Shapiro–Wilk test results with significance values greater than 0.05. Collectively, the learning achievement data across all units of analysis and analysis groups were normally distributed.

For collaborative skills data, most units of analysis were also normally distributed, with Kolmogorov–Smirnov and Shapiro–Wilk test results showing significance values greater than 0.05. However, the MPK and low kinesthetic talent (BKR) groups yielded significance values below 0.05 for both tests. When the significance threshold was adjusted to 0.01, the Shapiro–Wilk test results for the MPK and BKR groups indicated normal distributions. Therefore, collectively, the collaborative skills data across all units of analysis and analysis groups were considered normally distributed.

All values of Levene's statistic showed significance levels greater than 0.05. This indicates that the null hypothesis, stating "the variance between groups of learning models is not different", is accepted. In other words, the variances among the groups of learning models were homogeneous for both learning achievement and collaborative skills variables.

Similarly, the Levene's test results for kinesthetic talent groups yielded significance values greater than 0.05. This finding indicates that the null hypothesis stating that there were no differences in variance between kinesthetic talent groups was accepted. Thus, the variances among kinesthetic talent groups were homogeneous for both learning achievement and collaborative skills variables.

Product Moment Correlation $r_{count} = 0.550$ and $Sig. (2-tailed) = 0.000$. Because $r_{count} < 0.8$ and $Sig. (2-tailed) < 0.05$, it can be concluded that there is no significant collinear relationship between learning achievement variables and collaborative skills. F value = 1.028 with $p > 0.05$. The significance figure is greater than 0.05. This means that the null hypothesis, which states "the variance matrix between dependent variables is not different", is accepted. So, the variance matrix between learning achievement variables and collaborative skills is the same (homogeneous). Based on the results of the prerequisite tests, namely normality test, homogeneity test, collinearity test and variance-covariance homogeneity test, it can be concluded that the data from all groups are normally distributed, not collinear and homogeneous. Therefore, hypothesis testing with MANOVA can be continued.

Hypothesis testing in this study was conducted through statistical methods using MANOVA factorial 2 2 using the SPSS 22.0 for Windows computer program. The MANOVA factorial 2 2 multivariate test intends to examine the effect of each independent variable on the dependent variable together. The results of the analysis are presented in Tables 1, 2, and 3.

Based on the results shown in Table 1, the two-way MANOVA analysis yielded significant multivariate statistics, as indicated by Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root, each with an F value of 15.13 and $p < 0.05$. The analysis revealed that students who were taught using the interactive multimedia–assisted problem-based learning model (MPBM-MI) achieved higher mean scores in learning achievement and collaborative skills ($M = 64.47$, $SD = 6.27$; and $M = 61.13$, $SD = 5.95$, respectively), both categorized as sufficient. In contrast, students who were taught using the conventional learning model achieved lower mean scores in learning achievement and collaborative skills ($M = 58.97$, $SD = 4.04$; and $M = 55.88$, $SD = 5.96$), both categorized as low. These results indicate that students who followed the MPBM-MI model demonstrated better learning achievement and collaborative skills than those who followed the conventional learning model.

Table 1. Summary of Multivariate Test Results

Effect	Statistic	Value	F	Hypothesis df	Error df	Sig.
Intercept	<i>Pillai's Trace</i>	0,996	7171,856	2,000	59,000	0,000
	<i>Wilk's Lambda</i>	0,004	7171,856	2,000	59,000	0,000
	<i>Hotelling's Trace</i>	243,114	7171,856	2,000	59,000	0,000
	<i>Roy's Largest Root</i>	243,114	7171,856	2,000	59,000	0,000
MP	<i>Pillai's Trace</i>	0,339	15,133	2,000	59,000	0,000
	<i>Wilk's Lambda</i>	0,661	15,133	2,000	59,000	0,000
	<i>Hotelling's Trace</i>	0,513	15,133	2,000	59,000	0,000
	<i>Roy's Largest Root</i>	0,513	15,133	2,000	59,000	0,000
BK	<i>Pillai's Trace</i>	0,119	4,000	2,000	59,000	0,023
	<i>Wilk's Lambda</i>	0,881	4,000	2,000	59,000	0,023
	<i>Hotelling's Trace</i>	0,136	4,000	2,000	59,000	0,023
	<i>Roy's Largest Root</i>	0,136	4,000	2,000	59,000	0,023
MP*BK	<i>Pillai's Trace</i>	0,227	8,668	2,000	59,000	0,001
	<i>Wilk's Lambda</i>	0,773	8,668	2,000	59,000	0,001
	<i>Hotelling's Trace</i>	0,294	8,668	2,000	59,000	0,001
	<i>Roy's Largest Root</i>	0,294	8,668	2,000	59,000	0,001

Table 2. Summary of Multivariate Test Results on High Kinesthetic Talent (BKT)

Effect	Statistic	Value	F	Hypothesis df	Error df	Sig.
Intercept	<i>Pillai's Trace</i>	0,995	3147,122	2,000	29,000	0,000
	<i>Wilk's Lambda</i>	0,005	3147,122	2,000	29,000	0,000
	<i>Hotelling's Trace</i>	217,043	3147,122	2,000	29,000	0,000
	<i>Roy's Largest Root</i>	217,043	3147,122	2,000	29,000	0,000
MP	<i>Pillai's Trace</i>	0,579	19,905	2,000	29,000	0,000
	<i>Wilk's Lambda</i>	0,421	19,905	2,000	29,000	0,000
	<i>Hotelling's Trace</i>	1,373	19,905	2,000	29,000	0,000
	<i>Roy's Largest Root</i>	1,373	19,905	2,000	29,000	0,000

Table 3. Summary of Multivariate Test Results on Low Kinesthetic Talent (BKR)

Effect	Statistic	Value	F	Hypothesis df	Error df	Sig.
Intercept	<i>Pillai's Trace</i>	0,996	4120,987	2,000	29,000	0,000
	<i>Wilk's Lambda</i>	0,003	4120,987	2,000	29,000	0,000
	<i>Hotelling's Trace</i>	289,087	4120,987	2,000	29,000	0,000
	<i>Roy's Largest Root</i>	289,087	4120,987	2,000	29,000	0,000
MP	<i>Pillai's Trace</i>	0,054	0,833	2,000	29,000	0,445
	<i>Wilk's Lambda</i>	0,946	0,833	2,000	29,000	0,445
	<i>Hotelling's Trace</i>	0,057	0,833	2,000	29,000	0,445
	<i>Roy's Largest Root</i>	0,057	0,833	2,000	29,000	0,445

As shown in Table 1, the interaction effect between the learning model and kinesthetic talent (MP × BK) was statistically significant. The two-way MANOVA results produced significant values for Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root, each with an F value of 8.67 and $p < 0.05$. This finding indicates a significant interaction between the learning model and kinesthetic talent in influencing students' learning achievement and collaborative skills ($p < 0.05$).

Based on the results presented in Table 2, the two-way MANOVA analysis for students with high kinesthetic talent yielded significant multivariate statistics, with Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root each showing an F value of 19.91 and $p < 0.05$. The results indicated that students with high kinesthetic talent who were taught using the MPBM-MI model achieved higher mean scores in learning achievement and collaborative skills ($M = 67.56$, $SD = 6.43$; and $M = 65.50$, $SD = 4.82$), both categorized as sufficient. Meanwhile, students in the conventional learning model group obtained lower mean scores in learning achievement and collaborative skills ($M = 58.50$, $SD = 4.19$; and $M = 55.00$, $SD = 6.11$), both categorized as low. These findings demonstrate that, among students with high kinesthetic talent, the interactive multimedia-assisted problem-based learning model resulted in superior learning achievement and collaborative skills compared to the conventional learning model.

Based on the results shown in Table 3, the results of the two-way MANOVA calculation obtained the statistical values of Pillai's Trace, Wilk's Lambda, Hotelling's Trace, and Roy's Largest Root each with $F = 0.83$ and $p > 0.05$. The results of data analysis showed that at low kinesthetic aptitude, the interactive multimedia-assisted problem-based learning model group had an average value of learning achievement and collaborative skills of 61.38, $SD = 4.43$ with sufficient category and 57.50, $SD = 4.82$ with poor category. The conventional learning model group has an average value of learning achievement and collaborative skills of 59.44, $SD = 3.96$ with a category of less and 56.75, $SD = 5.88$ with a category of less. So from the results of data analysis shows that for students who have low kinesthetic talent, the learning achievement of students who follow the interactive multimedia-assisted problem-based learning model is better than that of students who follow the conventional learning model. In contrast, for students' collaborative skills, both interactive multimedia-assisted problem-based learning model groups and conventional learning model groups have a less category. However, when tested with a two-way MANOVA, the learning achievement and collaborative skills of students who followed the interactive multimedia-assisted problem-based learning model do not differ from those of students who followed the conventional learning model.

Overall, students who were taught using the interactive multimedia-assisted problem-based learning model achieved higher learning achievement and collaborative skills than those who were taught using the conventional learning model. However, descriptively, the levels of learning achievement and collaborative skills in the MPBM-MI group had not yet reached a high standard of success, as they were generally categorized as sufficient for both high and low kinesthetic talent groups, while outcomes in the conventional learning model group were predominantly categorized as low. The results of this study seem to be consistent with research conducted (Indrawan et al., 2017) shows that 1) There is a significant influence of the Problem Based Learning Model on learning motivation with a probability value (sig.) $0.001 < 0.05$. 2) the Problem Based Learning Model has a significant influence on soccer playing skills with a probability value (Sig.) $0.002 < 0.05$.

DISCUSSION

Previous studies have demonstrated the effectiveness of various student-centered learning models in improving learning outcomes in sports education. Panuntun (2020) reported that both the Teams Games Tournament and Problem-Based Learning (PBL) models had a significant effect on students' soccer learning outcomes at the senior vocational school level. Similarly, Wahyudi (2015) found that the application of a PBL model significantly improved students' performance in the front roll with bent legs in physical education, sports, and health learning at the elementary school level. In addition, Damanik (2019) showed that the implementation of the PBL model enhanced students' learning outcomes in underhand volleyball passing at the junior high school level. The findings of the present study are consistent with these previous studies and support the theoretical foundation of PBL as an effective instructional approach. The results indicate that the use of an interactive multimedia-assisted PBL model contributes to improvements in both learning achievement and collaborative skills. The incorporation of interactive multimedia appears to increase students' enthusiasm and engagement in learning activities, leading to better learning outcomes compared to conventional learning models. Moreover, students who learned through the interactive multimedia-assisted PBL model were more actively involved in the learning process and demonstrated greater ability to solve learning-related problems through group discussions and collaborative activities.

Research conducted by Kao and Luo (2020) further supports these findings. Their study aimed to develop a multimedia-assisted learning environment for sports instruction and to compare its effectiveness with that of a traditional teaching approach. The results indicated that the technology-mediated approach positively influenced students' learning behaviors and knowledge acquisition. Although both instructional approaches were effective at the cognitive level, students who learned through multimedia-assisted instruction demonstrated higher cognitive performance than those who learned through traditional teaching methods. This suggests that students may prefer learning environments that integrate interactive multimedia (Kao & Luo, 2020).

The results of the present study also indicate that neither the interactive multimedia-assisted PBL model nor the conventional learning model was fully effective in maximizing learning achievement and collaborative skills among students with low kinesthetic talent. This finding suggests that additional or alternative instructional strategies may be required to better support students with lower kinesthetic aptitude. Further research is therefore needed to identify learning models that are more suitable for accommodating students with low kinesthetic talent in order to optimize both learning achievement and collaborative skills. Statistically, students with high kinesthetic talent demonstrated better learning achievement than those with low kinesthetic talent, which is consistent with previous findings reported by Artha et al. (2015).

This study examined the combined effects of interactive multimedia-assisted learning models and kinesthetic talent on students' learning achievement and collaborative skills. The interactive multimedia used in this study included instructional videos, interactive materials, and quizzes designed to promote active engagement. The findings provide new insights into how the integration of technological approaches with an understanding of individual learning characteristics can enhance educational outcomes.

The integration of technology in education represents an important aspect highlighted by this study. Although the use of interactive multimedia in learning is not a novel concept, this research emphasizes the importance of interactivity in fostering student engagement. Unlike traditional approaches in which technology functions merely as a passive tool, interactive

multimedia serves as an active medium for delivering instructional messages from educators to learners. When interactive multimedia enhances students' attention, comprehension, and learning outcomes, the learning process can be considered effective (Khaidir et al., 2021).

Another important contribution of this study lies in its focus on kinesthetic talent, which often receives less attention than visual and auditory learning styles. By acknowledging kinesthetic talent, this study opens opportunities for the development of more diverse and inclusive instructional strategies that better address students' individual differences.

A key finding of this research is the relationship between multimedia use and physical activity in learning. The results demonstrate that interactive multimedia can be effectively integrated with kinesthetic activities to create a more holistic learning experience. This approach not only enhances conceptual understanding but also supports the development of motor skills and collaborative competencies.

The findings further indicate that students who learned through interactive multimedia-assisted instruction showed improvements in academic performance. Clear visualizations and high levels of interactivity helped students understand learning materials more effectively and efficiently. Digital learning media also facilitated better interaction between teachers and students, increased students' interest in learning, improved learning outcomes, and enhanced motivation and innovation (Rahma et al., 2024). In addition, students with higher kinesthetic talent demonstrated better collaborative skills when engaged in group activities supported by interactive multimedia, as such activities encouraged cooperation through practical tasks and interactive simulations requiring student interaction.

Overall, this study reinforces the notion that there is no single instructional approach that is universally effective for all learners. By recognizing and utilizing students' kinesthetic talents, educators can design more varied and individualized learning strategies, thereby creating more inclusive and effective learning environments.

The practical implications of this study include the development of curricula that integrate interactive multimedia to increase student engagement and promote deeper learning. Teacher training is also essential to enable educators to identify diverse student talents and learning styles, including kinesthetic characteristics, and to use technology effectively to support these differences. Furthermore, classroom design should accommodate kinesthetic activities and multimedia use by providing flexible spaces that allow movement and easy access to technological tools.

In conclusion, this study highlights the importance of a comprehensive educational approach that combines technological integration with an understanding of individual learning characteristics. By utilizing interactive multimedia and accommodating kinesthetic talent, learning processes can become more effective and engaging, ultimately enhancing students' learning achievement and collaborative skills.

CONCLUSION

Based on the results of hypothesis testing and discussion in this study, a general proposition can be made that the learning model and kinesthetic aptitude are essential in achieving learning achievement and collaborative skills. There are differences in learning achievement and collaborative skills between students who learn with problem-based learning models assisted by interactive multimedia and groups of students who learn with conventional learning models. There is an interaction effect between the variables of interactive multimedia-assisted learning model and kinesthetic talent on learning achievement and collaborative skills. There are differences in learning achievement and collaborative skills between students who learn with interactive multimedia-assisted

problem-based learning models and those who learn with conventional learning models at high kinesthetic aptitude. There is no difference in learning achievement and collaborative skills between students who learn with interactive multimedia-assisted problem-based learning models and groups of students who learn with conventional learning models at low kinesthetic aptitude.

IMPLICATION

Based on the results of this study, several suggestions can be made to improve the quality of soccer course instruction in the future. Lecturers teaching soccer courses are encouraged to implement interactive multimedia-assisted problem-based learning models grounded in constructivist learning principles as an alternative approach to enhancing students' learning achievement and collaborative skills. In implementing this model, the use of authentic, real-world problems presented through student worksheets is strongly recommended to support meaningful learning experiences. Lecturers teaching courses other than soccer should also consider students' characteristics, including learning styles and talents, when selecting appropriate instructional models. In particular, interactive multimedia-assisted problem-based learning may be especially beneficial for students with high kinesthetic talent. Finally, future research is recommended to further examine the effectiveness of different learning models for students with low kinesthetic talent, both in soccer courses and in other academic contexts, to identify instructional approaches that can better accommodate diverse learner profiles.

AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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