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Research Article

The Relationship Between Perceived Hybrid Learning Implementation and Physics Learning Interest Among Vocational High School Students

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ABSTRACT
Hybrid learning has become increasingly relevant in vocational education, yet limited evidence explains how students' perceptions of its implementation relate to their interest in learning physics. This study examined the relationship between perceived hybrid learning implementation and physics learning interest among vocational high school students. A quantitative cross-sectional correlational design was employed involving 59 tenth-grade students from three purposively selected classes at UPT SMK Negeri 2 Pinrang, South Sulawesi, Indonesia. Data were collected using a 27-item perceived hybrid learning implementation questionnaire, a 16-item physics learning interest questionnaire, and classroom observations as supporting evidence. Questionnaire data were analyzed using descriptive statistics and simple linear regression. Students' perceived hybrid learning implementation scores ranged from 49 to 97 (M = 70.56, SD = 8.03), while physics learning interest scores ranged from 30 to 56 (M = 43.34, SD = 5.77). Classroom observations indicated relatively consistent hybrid-learning implementation across the three classes, although patterns of student participation varied. Regression analysis revealed a significant positive relationship between perceived hybrid learning implementation and physics learning interest, B = .284, SE = .087, β = .396, t(57) = 3.251, p = .002, accounting for approximately 15.7% of the variance in learning interest. These findings suggest that students who perceive hybrid learning more positively tend to report greater interest in physics. However, given the cross-sectional design, the relationship should be interpreted as associative rather than causal.

Keywords: *Hybrid Learning; Learning Interest; Physics Education; Student Perceptions; Vocational Education*

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1. Introduction

Learning interest is an important motivational-affective factor that directs students' attention, sustains their engagement, and encourages continued participation in learning activities. The four-phase model of interest development proposes that interest may begin as situational interest triggered by features of the learning environment and, when adequately supported, develop into more enduring forms of individual interest (Hidi & Renninger, 2006). This process is particularly relevant to physics education because students are expected to engage with abstract concepts, mathematical representations, and scientific phenomena whose relevance may not always be immediately apparent. Contextual relevance and meaningful learning experiences are therefore important for fostering students' interest in science (Potvin & Hasni, 2014). More recent evidence from physics classrooms further shows that instruction connected to students' interests and perceived relevance can strengthen situational interest and reduce behavioral disengagement (Brakhage et al., 2023).

Digital technologies provide additional possibilities for creating such varied and meaningful learning experiences. One increasingly established approach is the purposeful integration of face-to-face instruction with online learning activities, digital resources, and technology-mediated interaction. Although the literature commonly uses the term blended learning for this configuration, the present study uses hybrid learning to refer to the integration of face-to-face and online learning within the same physics course. Its pedagogical value lies not simply in using technology but in connecting the two learning modes in ways that extend access to resources, interaction, feedback, and opportunities for active learning (Garrison & Kanuka, 2004; Graham, 2006). Contemporary reviews reinforce this distinction. A systematic review of school-based digital learning found that blended approaches generally produced more favorable outcomes than fully online instruction, although their effectiveness varied across learning conditions (Topping et al., 2022). Similarly, a recent meta-analysis of 133 studies involving 18,464 participants found an overall positive effect of blended learning on student performance, while also showing that teaching methods, the proportion of online learning, and forms of online interaction moderated its effectiveness (Yu et al., 2025).

These findings suggest that the presence of online and face-to-face components alone is insufficient to characterize an effective hybrid learning environment. What matters is how these components are organized and experienced by learners. A recent systematic review found positive relationships between blended-learning environments and academic, behavioral, cognitive, and affective engagement, while also emphasizing the importance of interaction, learning communities, peer involvement, and active instructional design (De Bruijn-Smolders & Prinsen, 2024). Students' perceptions are therefore relevant because learners participating in the same instructional arrangement may differ in how they experience teacher support, interaction, accessibility, integration, and opportunities to participate. Evidence from blended-learning environments also indicates that perceived teaching presence can contribute to students' autonomous motivation through the satisfaction of their needs for autonomy, competence, and relatedness (Adam et al., 2023). Consequently, examining perceived hybrid learning implementation provides a more learner-centered perspective than simply classifying a course as hybrid or non-hybrid.

This issue is especially important in physics education. Online components can provide simulations, videos of physical phenomena, worked examples, digital assignments, and asynchronous access to learning resources, whereas face-to-face sessions can provide opportunities for experiments, problem solving, conceptual discussion, and immediate feedback. However, these affordances do not automatically generate stronger engagement or interest. Hybrid learning environments can also create problems related to workload, technological access, weak interaction, or poorly coordinated learning activities. In vocational education and training contexts, for example, collaborative activities, technology integration, assessment, and feedback have been associated with students' attitudes, satisfaction, and motivation, while poorly designed learning arrangements may contribute to overload or disengagement (Radovan & Makovec Radovan, 2024). Thus, the potential of hybrid learning depends on whether technological and pedagogical elements are integrated in ways that make the learning experience meaningful to students.

The vocational-school context adds another important dimension. Unlike general academic programs, vocational education is expected to connect conceptual knowledge with occupational competencies, practical activities, and the demands of students' fields of specialization. A recent systematic review of blended learning in vocational education identified student engagement, motivation, satisfaction, pedagogical design, technological conditions, and learner-centered support as central issues in effective implementation (Song & Lai, 2025). In Indonesia, Wahjusaputri et al. (2024) similarly demonstrated the potential of a hybrid teaching-factory model that combined online and face-to-face learning in vocational high schools, particularly by providing varied opportunities for interaction, discussion, and active participation. These findings indicate that hybrid learning in vocational education needs to do more than provide digital access; it should also connect learning activities with the practical and disciplinary experiences relevant to vocational students.

Indonesian physics-education research provides additional evidence for the potential of this approach. Yunita et al. (2021) found that blended learning combined with practical activities produced greater gains in physics learning outcomes among vocational-school students than the comparison condition. In another secondary-school physics study, Dewanda and Dwikoranto (2022) reported favorable learning-interest outcomes when guided inquiry was implemented through blended learning. Together, these studies suggest that integrating online and face-to-face activities can support physics learning and that learning interest can be responsive to the instructional environment. Nevertheless, these Indonesian studies primarily evaluated blended learning as part of an instructional intervention and focused on outcomes such as achievement or post-intervention interest. They provide less evidence about whether differences in students' perceptions of how hybrid learning is implemented are associated with differences in their physics learning interest, particularly among vocational high school students.

This distinction represents an important empirical gap. Recent international research has increasingly emphasized that blended-learning outcomes depend on instructional design, interaction, learner experience, and the quality of integration between online and face-to-face components rather than on technology use alone. Research in vocational education likewise highlights the importance of engagement and learner-centered implementation (Song & Lai, 2025). However, the intersection of these issues remains insufficiently examined in vocational high school physics: existing evidence says relatively little about whether students who perceive hybrid learning as more positively implemented also report stronger interest in learning physics. Examining this relationship is relevant because students within the same hybrid-learning context may not experience its integration, resources, interaction, and support in the same way. Understanding this variation can contribute to a more nuanced evaluation of hybrid learning and provide evidence for designing physics instruction that is responsive to the characteristics of vocational learners.

Accordingly, this study examined the relationship between perceived hybrid learning implementation and physics learning interest among vocational high school students. Specifically, it aimed to (1) describe students' perceptions of hybrid learning implementation in physics instruction, (2) describe their physics learning interest, and (3) determine whether perceived hybrid learning implementation was significantly related to physics learning interest. Consistent with the correlational design, the study did not assume a causal relationship between the two constructs. It was hypothesized that students reporting more positive perceptions of hybrid learning implementation would also report higher levels of physics learning interest.

2. Method

2.1. Research Design and Participants

This study employed a quantitative cross-sectional correlational design to examine the relationship between students' perceived hybrid learning implementation and their interest in learning physics. The study was conducted during the even semester of the 2024/2025 academic year at UPT SMK Negeri 2 Pinrang, South Sulawesi, Indonesia. The variables were measured after hybrid learning had been implemented as part of the students' regular physics instruction; no instructional treatment was assigned or manipulated by the researchers. Accordingly, the design was intended to identify the direction and magnitude of the relationship between the two variables rather than to establish a causal effect.

The target population consisted of 342 tenth-grade students distributed across 14 classes and six vocational programs. The final sample comprised 59 students from three intact classes: X Agribisnis Perikanan 1, X Agribisnis Perikanan 2, and X Pengembangan Perangkat Lunak dan Gim 2. The classes were purposively selected because hybrid learning had been implemented in their physics instruction. Because the sample was drawn from three classes within a single vocational high school using nonprobability sampling, the findings are interpreted within this specific educational context and should not be generalized beyond comparable settings without caution.

Hybrid physics instruction combined face-to-face classroom activities with digitally supported learning. Face-to-face sessions were used to communicate learning objectives, explain physics content, and facilitate interaction, while digital platforms and learning resources were used to reinforce concepts and support subsequent learning activities. Classroom records indicated that students participated in teacher explanation, group discussion, digital tasks, use of visual learning materials, and access to additional online resources. This instructional setting provided the context in which students evaluated their experiences of hybrid learning.

2.2. Instruments and Data Collection

Two questionnaires were used to obtain the individual-level data for the main analysis. Perceived hybrid learning implementation was measured using a 27-item questionnaire covering students' experiences with online learning resources, participation in online and face-to-face activities, focus, comprehension, enjoyment, and integration of the two learning modes. Physics learning interest was measured using a 16-item questionnaire addressing attention, enjoyment, participation, persistence, information seeking, and willingness to engage in physics learning. Both instruments used a four-point Likert-type response format. Negatively worded items were reverse-coded before total scores were calculated so that higher scores consistently represented more positive perceptions of hybrid learning implementation or stronger physics learning interest.

Before their use in the main study, questionnaire items were subjected to item analysis using Pearson product–moment correlations, while internal consistency was assessed using Cronbach's alpha. The questionnaires were subsequently administered to the 59 participating students after they had experienced hybrid physics instruction, and individual total scores were used in the statistical analysis.

Classroom observation was used as a complementary source of evidence regarding the implementation of hybrid learning. The observation sheet documented students' attention, activeness, engagement in learning activities, digital skills, and ability to relate learning materials to contextual or everyday situations. Observations were conducted across the three participating classes and summarized at the class level. The records showed variation in participation and use of digital resources while also indicating a broadly comparable hybrid-learning structure across classes. The observation data were used only to contextualize the questionnaire findings and were not included as variables in the regression model.

2.3. Data Analysis

Questionnaire data were coded and analyzed using IBM SPSS Statistics version 23. Descriptive statistics were first calculated for both main variables, including the number of participants, minimum and maximum scores, means, and standard deviations. Observation scores were analyzed separately at the class level using minimum, maximum, mean, and standard deviation values.

Because the primary aim of the study was to examine the relationship between perceived hybrid learning implementation and physics learning interest, both questionnaire variables were treated as continuous measures. Before conducting the regression analysis, the normality of the regression residuals was examined using the one-sample Kolmogorov–Smirnov test. Normality was assessed using the unstandardized residuals, and a significance value greater than .05 was interpreted as indicating no statistically significant departure from normality.

Simple linear regression was then conducted with physics learning interest as the dependent variable and perceived hybrid learning implementation as the predictor. Statistical significance was evaluated at $\alpha = .05$. The analysis reported the unstandardized regression coefficient (B), standard error (SE), standardized regression coefficient (β), t statistic, p value, and 95% confidence interval. The regression equation was used to estimate changes in physics learning interest associated with differences in perceived hybrid learning implementation, while the coefficient of determination (R^2) was used to indicate the proportion of variance in physics learning interest accounted for by the predictor. Given the cross-sectional correlational design, all regression results were interpreted as statistical associations rather than causal effects.

3. Results

Descriptive analysis was conducted on data from 59 vocational high school students. As presented in Table 1, perceived hybrid learning implementation scores ranged from 49 to 97, with a mean of 70.56 (SD = 8.03). Physics learning interest scores ranged from 30 to 56, with a mean of 43.34 (SD = 5.77). The dispersion of scores indicates meaningful variability in both variables, allowing differences in students' perceptions of hybrid learning implementation to be examined in relation to differences in their physics learning interest.

Table 1. Descriptive Statistics of the Study Variables

Variable	N	Minimum	Maximum	M	SD
Perceived hybrid learning implementation	59	49.00	97.00	70.56	8.03
Physics learning interest	59	30.00	56.00	43.34	5.77

Note. M = mean; *SD* = standard deviation.

The descriptive results show that students did not perceive hybrid learning implementation uniformly. Scores were distributed across a relatively broad range, suggesting differences in how students experienced the combination of face-to-face instruction, digital learning resources, and online activities. Physics learning interest also varied across participants, indicating that students reported different levels of interest in learning physics.

Classroom observations provided additional information about how hybrid learning was implemented across the three participating classes. The observation records showed that face-to-face explanations were combined with digital resources and online learning activities. In Class X Agribisnis Perikanan 1, most students attended to the teacher's explanations, although active participation was concentrated among several students. In Class X Agribisnis Perikanan 2, participation was more varied, particularly during group discussions and digital tasks, while students appeared more responsive when visual media and contextual examples were used. In Class X Pengembangan Perangkat Lunak dan Gim 2, students showed relatively active participation in questioning, discussion, and the use of additional digital learning resources.

The observation scores across the three classes ranged from 75 to 78, with a mean of 76.33 and a standard deviation of 1.53 (Table 2). The narrow range indicates relatively limited variation in the overall observed implementation of hybrid learning across the three classes, although differences in patterns of student participation were evident from the observation records.

Table 2. Summary of Classroom Observations of Hybrid Learning Implementation

Statistic	Value
Number of classes observed	3
Minimum score	75
Maximum score	78
Mean	76.33
SD	1.53

Note. Observation scores summarize the implementation of hybrid learning across the three participating classes.

Taken together, the questionnaire and observation findings provide complementary information. The classroom observations indicate that a broadly comparable hybrid-learning structure was implemented across the three classes, whereas the wider variation in student questionnaire scores suggests that students differed in how they perceived and experienced that implementation. This distinction supports the use of **perceived hybrid learning implementation** as the predictor examined in the subsequent analysis.

Before testing the relationship between the two variables, the normality of the regression residuals was examined. The one-sample Kolmogorov–Smirnov test conducted on the unstandardized residuals yielded $D = .109$, $p = .078$. Because the result was not statistically significant, no significant departure from normality was detected, supporting the use of linear regression for the available data.

Simple linear regression was then used to examine the relationship between perceived hybrid learning implementation and physics learning interest. The results are presented in Table 3.

Table 3. Simple Linear Regression Predicting Physics Learning Interest

Predictor	B	SE	β	t	p	95% CI for B
Constant	23.301	6.202	—	3.757	< .001	—
Perceived hybrid learning implementation	.284	.087	.396	3.251	.002	[.110, .458]

Note. Dependent variable = physics learning interest; *N* = 59. *B* = unstandardized regression coefficient; *SE* = standard error; β = standardized regression coefficient; CI = confidence interval.

Perceived hybrid learning implementation was positively and statistically significantly associated with physics learning interest, *B* = .284, *SE* = .087, β = .396, *t*(57) = 3.251, *p* = .002. The positive coefficient indicates that students who reported more favorable perceptions of hybrid learning implementation also tended to report higher levels of physics learning interest. Specifically, a one-point increase in the perceived hybrid learning implementation score was associated with an estimated 0.284-point increase in the predicted physics learning interest score.

The regression equation was:

$$Y = 23.301 + 0.284X$$

where *Y* represents physics learning interest and *X* represents perceived hybrid learning implementation. The standardized coefficient (β = .396) indicates a moderate positive relationship between the two variables. For this single-predictor model, the corresponding proportion of variance accounted for was approximately 15.7% ($R^2 \approx .157$). Thus, perceived hybrid learning implementation showed a meaningful statistical relationship with physics learning interest, while most of the variation in students' interest remained associated with factors outside the present model.

4. Discussion

4.1. Perceived Hybrid Learning Implementation in Vocational Physics Learning

The findings show that students varied considerably in how they perceived the implementation of hybrid learning, even though classroom observations indicated relatively limited variation in the overall implementation across the three participating classes. The observation scores ranged from 75 to 78, whereas students' perceived hybrid learning implementation scores ranged much more widely from 49 to 97. This difference is important because it suggests that exposure to a broadly similar instructional arrangement does not necessarily result in the same learning experience for every student. In a blended environment, students may perceive access to resources, interaction, instructional support, and opportunities for participation differently even when they participate in the same general learning structure.

This interpretation is consistent with ElSayad (2024), who found that students' perceptions of learning in blended environments are associated with academic self-efficacy, student–student interaction, student–teacher interaction, and metacognitive self-regulation. These findings emphasize that students are active participants in constructing their experiences of blended learning rather than passive recipients of a uniform instructional model. In vocational education, this issue may be even more important because online learning needs to accommodate practical and competency-oriented activities. Resmiaty et al. (2021), for example, showed that the implementation of blended learning in vocational education needs to consider students' learning conditions, technological access, and difficulties associated with practical subject matter.

The classroom observation records in the present study provide contextual support for this interpretation. Students in X Agribisnis Perikanan 1 generally followed classroom explanations, although active participation was concentrated among some students. In X Agribisnis Perikanan 2, participation was more varied, particularly during group discussion and digital tasks, while students appeared more responsive when visual media and contextual examples were used. Students in X Pengembangan Perangkat

Lunak dan Gim 2 showed comparatively active questioning, discussion, and use of supplementary digital learning resources. These observations should not be interpreted as statistically established differences between classes, but they illustrate how patterns of participation may differ within a broadly comparable hybrid-learning structure.

The distinction between observed implementation and student perception therefore strengthens the conceptualization adopted in this study. What is measured by the questionnaire is not simply whether hybrid learning occurred, but how positively students perceived its implementation. This learner-centered perspective is more informative than treating hybrid learning as a binary condition because it acknowledges that instructional arrangements may be experienced differently by individual students.

4.2. Physics Learning Interest in the Hybrid Learning Context

The descriptive results also revealed meaningful variation in physics learning interest, with scores ranging from 30 to 56. Such variation is theoretically plausible because learning interest is not determined solely by stable personal characteristics; it can also be influenced by features of the learning environment. Hidi and Renninger's (2006) interest-development framework proposes that situational interest may be triggered by environmental conditions and maintained when learners repeatedly encounter meaningful and engaging experiences. In physics education, this is particularly relevant because abstract concepts may become more engaging when students can connect them with observable phenomena, practical applications, or personally meaningful contexts.

Recent evidence supports this interpretation. Brakhage et al. (2023) demonstrated in a classroom-based physics study that instructional approaches designed around students' interests and perceived relevance can foster situational interest and reduce behavioral disengagement. The present observation records similarly indicate that students appeared more responsive when learning materials were presented through visual media and contextual examples. Although the current study did not experimentally test these particular instructional features, the observational evidence suggests that contextualization and representation may be relevant features of students' hybrid physics experiences.

Evidence from Indonesia provides further contextual support. Dewanda and Dwikoranto (2022) examined guided inquiry supported by blended learning in secondary-school physics and reported favorable outcomes for students' learning interest. Their intervention design differs from the correlational approach employed here, so the two studies should not be treated as directly equivalent. Nevertheless, both indicate that students' interest in physics is meaningfully connected with the instructional environments through which physics is experienced.

The present study adds a somewhat different perspective. Rather than asking whether a particular blended-learning intervention increases interest, it examines variation among students already learning within a hybrid environment. The results therefore suggest that even within the same broad instructional model, students may report substantially different levels of physics learning interest. This variation provides an important basis for examining how students' perceptions of the learning environment relate to their interest.

4.3. Relationship Between Perceived Hybrid Learning Implementation and Physics Learning Interest

The central finding of this study is the positive and statistically significant relationship between perceived hybrid learning implementation and physics learning interest. The standardized regression coefficient (β = .396) indicates a moderate positive association, and the regression model accounted for approximately 15.7% of the variance in physics learning interest. Students who evaluated the implementation of hybrid learning more positively therefore tended to report stronger interest in learning physics.

One possible explanation concerns the motivational conditions created by well-integrated learning environments. Hybrid learning can extend opportunities for interaction, access to materials, feedback, flexibility, and participation, but these opportunities are likely to matter only when students perceive them as meaningful and supportive. Adam et al. (2023) found that perceived teaching presence in blended-learning environments contributed to autonomous motivation through students' satisfaction of needs related to autonomy, competence, and relatedness. From this perspective, the relationship found in the present study may partly reflect students' responses to learning environments that provide meaningful guidance while also allowing greater access and participation.

This interpretation is also compatible with the design perspective proposed by Marcellis et al. (2024), who emphasize that motivating blended-learning environments require purposeful integration of online and offline activities that support students' autonomy, competence, and relationships with teachers and peers. The present study did not directly measure these psychological mechanisms, so they should be treated as theoretically plausible explanations rather than demonstrated mediators. Nevertheless, they help explain why students' perceptions of implementation may be more relevant to interest than the mere availability of digital technology.

Student engagement provides another possible explanatory pathway. De Bruijn-Smolders and Prinsen's (2024) systematic review found generally positive effects of blended-learning interventions on academic, behavioral, cognitive, and affective engagement. Their review also highlights the importance of active participation and appropriately designed blended-learning environments. This evidence is consistent with the present observation records, in which patterns of participation, discussion, use of digital resources, and responsiveness to visual or contextual material varied across students and classes. It therefore appears reasonable to interpret students' perceptions of implementation as reflecting, at least partly, the quality of opportunities they experienced for engaging with physics learning.

The vocational context makes this relationship particularly significant. Vocational learning is expected to connect disciplinary knowledge with practical competencies and occupationally relevant experiences. Song and Lai's (2025) systematic review of vocational blended learning identified pedagogical design, technological support, learner characteristics, motivation, satisfaction, and engagement as important elements shaping the effectiveness of blended environments. Similarly, Jiang et al. (2024) reported improvements in student presence, motivation, satisfaction, and academic performance in a blended-learning environment within higher vocational education, with student presence emerging as an important factor. Although these studies involve different educational levels and contexts, they reinforce the importance of how vocational students participate in and experience blended learning.

The magnitude of the present relationship nevertheless requires careful interpretation. An R^2 of approximately .157 indicates that perceived hybrid learning implementation accounted for about 15.7% of the observed variance in physics learning interest. Consequently, approximately 84.3% of the variance was not accounted for by this single predictor. This does not invalidate the relationship; rather, it indicates that students' interest in physics is likely associated with multiple individual, instructional, and contextual factors. Prior experiences with physics, academic self-efficacy, self-regulation, teacher support, peer interaction, perceived task relevance, and access to technology are among the factors that may contribute to differences in students' interest.

The result should also be interpreted within the limitations of the research design. Because perceived hybrid learning implementation and physics learning interest were measured at the same time, temporal direction cannot be established. More positive perceptions of hybrid learning may be associated with stronger interest, but it is also possible that students who were already more interested in physics evaluated their learning experiences more positively. Furthermore, both principal variables were measured using self-report questionnaires, which may introduce shared method effects. The findings therefore demonstrate a cross-sectional association rather than a causal effect. Longitudinal and experimental research will be required to establish whether changes in the quality of hybrid-learning implementation are followed by changes in physics learning interest.

4.4. Implications, Limitations, and Directions for Future Research

The findings suggest that efforts to improve hybrid physics learning should focus on the quality of integration rather than simply increasing the amount of technology used. Online activities should have a clear pedagogical relationship with face-to-face activities. Digital resources may be particularly useful for visualization, preparatory learning, repeated access to materials, and differentiated practice, whereas classroom activities can provide opportunities for experimentation, discussion, direct feedback, and practical application. Such integration may be especially relevant in vocational education, where students are expected to connect conceptual knowledge with occupationally meaningful tasks.

Indonesian vocational-education research provides useful examples of this direction. Wahjusaputri et al. (2024) reported that a hybrid teaching-factory approach offered varied opportunities for interaction and discussion and supported active participation in vocational learning. More recently, Saputri and Fransisca (2026) developed adaptive hybrid-learning media combining Android and web platforms for vocational students and reported highly positive student responses to the learning environment. These studies reinforce the importance of designing technological components around students' learning needs and vocational contexts rather than treating digital media as an additional delivery channel.

The observational findings of the present study point in a similar direction. Students appeared more responsive when instruction involved visual resources and contextual examples, while the use of supplementary digital resources was particularly visible among students in the Software and Game Development class. These patterns suggest potential areas for instructional development, although the present design cannot determine whether any particular activity directly produced stronger learning interest. Future research could therefore examine specific features of hybrid physics instruction, such as simulation use, contextualized vocational problems, teacher feedback, student autonomy, and online–face-to-face integration, as separate predictors of interest and engagement.

Several limitations should guide the interpretation and extension of the findings. First, the sample consisted of 59 students drawn purposively from three classes within a single vocational high school, limiting generalizability beyond comparable settings. Second, students were nested within intact classes, and possible class-level influences could not be adequately separated with only three classroom clusters. Third, the cross-sectional design prevents conclusions about causal direction. Fourth, reliance on student self-report for both principal variables may have contributed to shared method variance.

Finally, the current model included only one predictor and therefore could not determine how hybrid-learning perceptions operate alongside other potentially important factors.

Future studies should involve multiple vocational schools and larger samples representing different vocational programs. Longitudinal research could assess whether changes in perceived implementation precede changes in learning interest, while quasi-experimental studies could compare alternative hybrid-learning designs. Future research should also combine student perceptions with more objective indicators of implementation, such as classroom observations, learning-platform activity, teacher reports, and instructional-design measures. Including additional predictors such as academic self-efficacy, self-regulation, teacher support, perceived vocational relevance, and prior physics achievement would provide a more comprehensive explanation of physics learning interest.

Overall, the findings support a learner-centered understanding of hybrid learning in vocational physics education. A broadly similar hybrid-learning structure was implemented across the participating classes, yet students differed substantially in how they perceived that implementation and in their reported physics learning interest. The moderate positive relationship between the two constructs suggests that the educational value of hybrid learning depends not only on combining online and face-to-face modes, but also on how students experience the quality and integration of those modes. This distinction represents the principal contribution of the present study and provides a useful direction for improving hybrid physics instruction in vocational-school contexts.

5. Conclusion

This study examined the relationship between perceived hybrid learning implementation and physics learning interest among vocational high school students. The findings show that students differed substantially in how they perceived the implementation of hybrid learning, although classroom observations indicated that the overall hybrid-learning structure was implemented relatively consistently across the three participating classes. Students also reported varying levels of interest in learning physics, indicating that both constructs differed meaningfully among participants.

The regression analysis demonstrated a significant positive relationship between perceived hybrid learning implementation and physics learning interest, with a moderate standardized association ($\beta = .396$, $p = .002$). The model accounted for approximately 15.7% of the variance in physics learning interest, indicating that students who perceived hybrid learning more positively also tended to report stronger interest in learning physics. However, most of the variance in learning interest remained associated with factors beyond the present model. The original inferential analysis likewise reported a significant positive regression coefficient for hybrid learning, $B = .284$, $t = 3.251$, $p = .002$.

These findings highlight the importance of considering students' experiences of hybrid learning rather than focusing only on whether online and face-to-face modes are formally combined. In vocational physics education, the quality of integration, accessibility of digital resources, opportunities for interaction, contextual relevance, and alignment with practical learning needs may be especially important for supporting students' interest. Nevertheless, because the study used a cross-sectional correlational design with a purposively selected sample from a single school, the findings should be interpreted as evidence of association rather than causation.

Future research should involve larger and more diverse vocational-school samples, include additional predictors of physics learning interest, and employ longitudinal or quasi-experimental designs to examine whether improvements in hybrid-learning implementation are followed by changes in students' interest over time. Combining student perceptions with classroom observations, teacher reports, and digital learning-activity data may also provide a more comprehensive understanding of how hybrid learning functions in vocational physics education.

References

Adam, M. S., Abd Hamid, J., Khatibi, A., & Azam, S. M. F. (2023). Autonomous motivation in blended learning: Effects of teaching presence and basic psychological need satisfaction. *Learning and Motivation, 83*, 101908. https://doi.org/10.1016/j.lmot.2023.101908

Brakhage, H., Gröschner, A., Gläser-Zikuda, M., & Hagenauer, G. (2023). Fostering students' situational interest in physics: Results from a classroom-based intervention study. *Research in Science Education, 53*, 993–1008. https://doi.org/10.1007/s11165-023-10120-x

De Bruijn-Smolders, M., & Prinsen, F. R. (2024). Effective student engagement with blended learning: A systematic review. *Heliyon, 10*(23), e39439. https://doi.org/10.1016/j.heliyon.2024.e39439

Dewanda, G. P., & Dwikoranto. (2022). Pengaruh model inkuiri terbimbing berbasis blended learning materi teori kinetik gas dalam meningkatkan hasil belajar dan minat belajar. *Jurnal Penelitian Pembelajaran Fisika, 13*(2), 191–200. https://doi.org/10.26877/jp2f.v13i2.12442

ElSayad, G. (2024). Drivers of undergraduate students' learning perceptions in the blended learning environment: The mediation role of metacognitive self-regulation. *Education and Information Technologies, 29*, 15737–15760. https://doi.org/10.1007/s10639-024-12466-9

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education, 7*(2), 95–105. https://doi.org/10.1016/j.iheduc.2004.02.001

Graham, C. R. (2006). Blended learning systems: Definition, current trends, and future directions. In C. J. Bonk & C. R. Graham (Eds.), *The handbook of blended learning: Global perspectives, local designs* (pp. 3–21). Pfeiffer.

Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist, 41*(2), 111–127. https://doi.org/10.1207/s15326985ep4102_4

Jiang, W., Zhan, Y., Sun, D., Sun, J., & Tian, P. (2024). Exploring the effects of SPOC-based blended learning on students' learning performance at higher vocational education. *Interactive Learning Environments, 32*(10), 6949–6966. https://doi.org/10.1080/10494820.2023.2294774

Marcellis, M., Frerejean, J., Bredeweg, B., Brand-Gruwel, S., & van Merriënboer, J. J. G. (2024). Motivating students in competency-based education programmes: Designing blended learning environments. *Learning Environments Research, 27*, 761–776. https://doi.org/10.1007/s10984-024-09500-5

Potvin, P., & Hasni, A. (2014). Interest, motivation and attitude towards science and technology at K–12 levels: A systematic review of 12 years of educational research. *Studies in Science Education, 50*(1), 85–129. https://doi.org/10.1080/03057267.2014.881626

Radovan, M., & Makovec Radovan, D. (2024). Harmonizing pedagogy and technology: Insights into teaching approaches that foster sustainable motivation and efficiency in blended learning. *Sustainability, 16*(7), 2704. https://doi.org/10.3390/su16072704

Resmiaty, T., Chaeruman, U. A., & Kusumawardani, D. (2021). The implementation of blended learning in the new normal era at vocational school of health. *Jurnal Pendidikan Vokasi, 11*(2), 182–191. https://doi.org/10.21831/jpv.v11i2.42495

Saputri, R. P., & Fransisca, M. (2026). Development of hybrid learning media integrating Android and web platforms with an adaptive learning approach. *Jurnal Profesi Keguruan, 12*(1), 71–85. https://doi.org/10.15294/jpk.v12i1.52243

Song, S., & Lai, Y. C. (2025). Blended learning in vocational education: Benefits, challenges, and student engagement. *Cogent Education, 12*(1), 2548348. https://doi.org/10.1080/2331186X.2025.2548348

Topping, K. J., Douglas, W., Robertson, D., & Ferguson, N. (2022). Effectiveness of online and blended learning from schools: A systematic review. *Review of Education, 10*(2), e3353. https://doi.org/10.1002/rev3.3353

Wahjusaputri, S., Nastiti, T. I., & Liu, Y. (2024). Development of a hybrid teaching factory model based on school governance in improving employability skills of vocational students. *Jurnal Pendidikan Vokasi, 14*(1), 53–62. https://doi.org/10.21831/jpv.v14i1.65108

Yu, Q., Yu, K., Li, B., & Wang, Q. (2025). Effectiveness of blended learning on students' learning performance: A meta-analysis. *Journal of Research on Technology in Education, 57*(3), 499–520. https://doi.org/10.1080/15391523.2023.2264984

Yunita, H., Sesunan, F., Maulina, H., & Suana, W. (2021). Pembelajaran blended learning dengan metode praktikum untuk meningkatkan hasil belajar fisika siswa SMK. *Physics Education Research Journal, 3*(2), 133–140. https://doi.org/10.21580/perj.2021.3.2.8606