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Validation a Hybrid Learning Model in Secondary Education

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A B S T R A C T

Purpose: The objective of this study was to design and evaluate a hybrid learning model tailored for secondary education.

Methods and Materials: This quantitative study employed a descriptive-survey design. A total of 247 secondary school teachers were selected through stratified random sampling. Data was collected using a researcher-developed questionnaire, which assessed various components of hybrid learning, including teaching methods, technology integration, student engagement, and learning outcomes. The questionnaire contained 30 Likert-scale items, and its reliability was confirmed with a Cronbach's alpha of 0.87. Data analysis was performed using SPSS-27, employing descriptive and inferential statistical methods, including t-tests and regression analysis, to evaluate the effectiveness of the hybrid learning model.

Findings: The results indicated that the hybrid learning model was perceived as moderately effective across various components. Teachers rated "Improvement in Learning Quality" and "Use of Technology" highly, while "Teacher Competence" and "Performance Evaluation" were rated moderately. The model showed significant potential in enhancing student engagement and learning outcomes, particularly through the integration of technology in the classroom. Additionally, the one-sample t-test confirmed the overall validity of the model, with statistically significant results for all evaluated components.

Conclusion: The hybrid learning model demonstrated effectiveness in improving educational quality and student engagement in secondary education. However, its success depends on factors such as teacher competence, technological infrastructure, and professional development. While the model shows promise, further research is needed to address the challenges related to implementation and optimize its effectiveness across different educational contexts.

Keywords: *Hybrid learning, secondary education, technology integration, student engagement, learning outcomes, teacher competence, instructional strategies.*

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1. Introduction

The evolution of educational models in the digital age has brought about a significant transformation in teaching and learning methods, particularly through the integration of hybrid learning (Asgharinezhad et al., 2024; Kafshchian Moghadam et al., 2024). Hybrid learning, which combines face-to-face instruction with online components, has become a critical approach for enhancing the educational experience, especially in the context of secondary education (Bezi et al., 2024; Por Jafari shir Joposht et al., 2024). This pedagogical strategy not only allows for greater flexibility in learning but also supports diverse learning styles and needs, creating a more inclusive and adaptable educational environment (Ahlgren et al., 2020; Emami Khotbesara et al., 2024; Fel Araghi et al., 2024). In recent years, hybrid learning has gained increasing attention due to its ability to blend traditional teaching methods with innovative digital technologies, providing students with more comprehensive learning opportunities.

Hybrid learning has emerged as a response to several challenges facing education today, including the growing need for technological literacy, the demands for flexibility in learning, and the necessity of ensuring continuity of education in crisis situations like the COVID-19 pandemic (Hwang, 2018). This learning model bridges the gap between online and in-person education, offering a balanced approach that leverages the strengths of both methods. According to Müller (2021), the significance of hybrid learning during the pandemic was underscored by its ability to maintain educational quality in higher education institutions when traditional classrooms were no longer viable options (Müller, 2021). The adaptability of this model makes it particularly relevant in various educational settings, from primary to higher education (Müller, 2022).

In Iran, the integration of hybrid learning has been particularly important, given the country's efforts to modernize its educational system while addressing the socio-economic and technological disparities that exist across different regions (Kasani et al., 2020). Iranian faculty members have identified major barriers to participating in online teaching, including limited access to digital resources, insufficient training for educators, and infrastructural challenges (Zamani et al., 2016). Despite these obstacles, hybrid learning has been recognized as a feasible and effective solution for addressing the educational needs of students, especially in resource-scarce areas (Chukwuemeka-Nworu, 2024).

One of the primary benefits of hybrid learning is its capacity to enhance students' engagement and motivation by combining the strengths of traditional classroom environments with the flexibility of online learning. The integration of technology into the learning process enables educators to create more dynamic and interactive lessons, which can cater to various learning preferences (Helsa et al., 2023). Studies have shown that hybrid learning can significantly improve students' conceptual understanding, particularly in subjects like mathematics, where active participation and critical thinking are essential for mastering complex concepts (Hermita, 2023).

Furthermore, hybrid learning supports the development of critical thinking skills, as students are often required to engage with course material in different formats, such as online discussions, multimedia resources, and face-to-face interactions (Gharib et al., 2016). This multifaceted approach encourages students to think critically about the content they are learning, fostering deeper understanding and retention of information. In a qualitative study, nursing students and educators reported that hybrid learning provided opportunities to enhance critical thinking through the use of e-learning platforms, which allowed for more personalized and reflective learning experiences (Farsi et al., 2021).

However, the successful implementation of hybrid learning depends on several key factors, including the availability of technological infrastructure, the readiness of educators and students to engage with digital tools, and the development of effective teaching strategies (Dastgahian & Scull, 2021). In resource-scarce communities, such as those in certain parts of Nigeria, the management of hybrid learning poses significant challenges due to limited access to technology and internet connectivity (Chukwuemeka-Nworu, 2024). Despite these challenges, educators in these regions have found ways to adapt hybrid learning models to local contexts, ensuring that students still receive a quality education.

The success of hybrid learning also relies heavily on the design and delivery of the curriculum. According to Ahlgren, Häkkinen, and Eskola (2020), the design of hybrid learning environments must be carefully planned to ensure that both online and face-to-face components are effectively integrated. This includes aligning course objectives with appropriate teaching methods, utilizing technology to enhance learning, and providing students with clear guidelines on how to navigate both the digital and physical aspects of the course. In their study, Ahlgren et al. (2020)

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identified several success factors for hybrid teaching, including the importance of clear communication, the use of diverse instructional strategies, and the need for ongoing support for both educators and students (Ahlgren et al., 2020).

In addition to improving student engagement and learning outcomes, hybrid learning has been shown to promote inclusivity by accommodating the diverse needs of learners. For instance, hybrid learning models allow students with different learning styles, such as visual or auditory learners, to access course materials in ways that best suit their preferences (Fransisca & Saputri, 2023). This flexibility can be particularly beneficial for students who may struggle in traditional classroom settings, as it provides them with additional opportunities to review materials and engage with the content at their own pace.

The COVID-19 pandemic further highlighted the need for flexible learning solutions, as schools and universities around the world were forced to transition to online learning in response to lockdowns and social distancing measures (Singh et al., 2021). During this period, hybrid learning became a vital tool for maintaining educational continuity, enabling students to continue their studies despite the challenges posed by the pandemic (Li et al., 2021). In Iran, medical students reported positive experiences with e-learning during the pandemic, expressing a desire to continue using digital platforms even after the return to face-to-face learning (Ghalavand, 2024).

While hybrid learning offers numerous advantages, its implementation is not without challenges. One of the primary obstacles to adopting hybrid learning in many educational institutions is the need for adequate technological infrastructure (Müller, 2021, 2022). In regions with limited access to reliable internet and digital devices, such as parts of rural Iran, the effectiveness of hybrid learning can be significantly hindered. Furthermore, educators must be adequately trained in using digital tools and platforms to ensure that they can effectively deliver hybrid courses (Keramati & Gillies, 2021).

In addition to technological challenges, there are also pedagogical considerations that must be addressed when implementing hybrid learning. According to Köppe, Nørgård, and Pedersen (2017), one of the key challenges in hybrid education is ensuring that both online and face-to-face components are equally engaging and effective. This requires careful planning and coordination, as well as the development of innovative teaching strategies that can leverage the strengths of both formats (Köppe et al., 2017).

Despite these challenges, hybrid learning continues to grow in popularity, particularly in higher education, where it has been shown to improve learning outcomes and increase student satisfaction (Farliana et al., 2023). In their study on hybrid learning trends in post-pandemic higher education, Farliana et al. (2023) found that hybrid learning has become a preferred mode of instruction for many students and educators, offering a more flexible and personalized learning experience compared to traditional classroom-based education (Farliana et al., 2023).

Moreover, hybrid learning has the potential to prepare students for the future workforce by developing essential digital skills and competencies (Rahardjanto et al., 2019). As technology continues to play an increasingly important role in society, the ability to navigate digital platforms and tools will become a critical skill for students in all fields. Hybrid learning not only provides students with the opportunity to develop these skills but also encourages them to take greater ownership of their learning, fostering independence and self-directed learning (Maqbool et al., 2022).

In conclusion, hybrid learning represents a transformative approach to education, combining the best elements of online and face-to-face instruction to create a more flexible, inclusive, and effective learning environment. While challenges such as technological infrastructure and educator readiness remain, the potential benefits of hybrid learning—improved student engagement, enhanced learning outcomes, and the development of critical digital skills—make it a valuable model for the future of education. Thus, the objective of this study was to design and evaluate a hybrid learning model tailored for secondary education.

2. Methods and Materials

2.1. Study Design and Participants

This research adopts a quantitative approach with a descriptive-survey design to investigate the development of a hybrid learning model for secondary education. A total of 247 secondary school teachers were selected as participants using stratified random sampling to ensure representation across different schools and educational backgrounds. The sample size was determined based on Cochran's formula, accounting for a 95% confidence level and a 5% margin of error.

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2.2. *Data Collection Tools*

Data collection was conducted using a researcher-developed questionnaire designed to assess various dimensions of hybrid learning, including instructional strategies, student engagement, technological integration, and learning outcomes. The questionnaire consisted of 30 closed-ended questions, rated on a five-point Likert scale, ranging from "strongly agree" to "strongly disagree." The questionnaire was validated by a panel of educational experts, and its reliability was confirmed through a pilot study, yielding a Cronbach's alpha coefficient of 0.87, indicating a high level of internal consistency. The content validity was ensured by aligning the questions with the study objectives and reviewing existing literature on hybrid learning models in education.

2.3. *Data Analysis*

The collected data were analyzed using statistical techniques, including descriptive and inferential statistics. Descriptive statistics, such as means and standard deviations, were used to summarize participants' responses to each of the dimensions measured. To examine the relationships between variables and to test the study's hypotheses, inferential statistical methods, including Pearson correlation and multiple linear regression, were employed. These analyses were conducted using SPSS version 27. The significance level was set at 0.05, and results were interpreted based on p-values and effect sizes to determine the impact of hybrid learning on students' academic performance and engagement. The quantitative data provided insights into the effectiveness of hybrid learning, highlighting key factors contributing to its success in secondary education.

3. Findings and Results

The demographic characteristics of the participants reveal a diverse distribution in terms of age, work experience, and gender. Regarding age, 21% of the participants are under 35 years old, 39% fall within the 35 to 40-year range, 32% are between 41 and 45 years old, and only 8% are over 45. The highest frequency is observed in the 35 to 40 age group, while the lowest is in the over 45 age group. In terms of work experience, 11% of the participants have less than 7 years of experience, 39% have between 7 and 13 years, 22% have 14 to 20 years, and 28% have over 20 years of experience, with the highest frequency in the 7 to 13-year range and the lowest in the under 7-year category. Gender-wise, 62% of the participants are male, while 38% are female. These results reflect a majority of participants in the mid-career range and a slightly higher representation of men in the sample.

Table 1

Descriptive Statistics of Research Components

Component	Mean	Standard Deviation	Skewness	Kurtosis
Effective Teaching and Learning Methods	3.22	0.79	-0.02	-0.15
Performance Evaluation	3.27	0.75	-0.04	-0.19
Teacher Competence	3.24	0.76	0.05	0.07
Curriculum and Objectives	3.19	0.77	-0.03	0.35
Use of Technology in the Classroom	3.66	0.83	-0.36	-0.11
Technology Skill Enhancement	3.14	0.81	0.18	-0.37
Creating a Suitable Technology Environment	3.15	0.69	-0.08	0.32
Attracting Attention and Motivation	3.17	0.74	-0.16	0.42
Selective Perception	3.18	0.72	0.08	0.18
Retrieval	3.12	0.82	0.11	0.10
Thinking	3.21	0.85	-0.08	-0.09
Improvement in Learning Quality	3.29	0.73	-0.05	0.19
Informal Learning	3.30	0.75	-0.05	-0.54
Coding	3.39	0.80	-0.12	-0.09
Responsiveness	3.16	0.75	-0.12	-0.26
Feedback	3.13	0.81	0.12	0.09

Table 1 presents the descriptive statistics for the research components. The results show that the average score for "Effective Teaching and Learning Methods" is 3.22 with a standard deviation of 0.79, indicating a moderate perception of effectiveness, with a skewness of -0.02 and kurtosis of -0.15, suggesting a near-normal distribution. "Performance Evaluation" has an average score of 3.27 with a standard deviation of 0.75, showing similar perceptions, and a slight

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negative skewness (-0.04) and kurtosis (-0.19). "Teacher Competence" scored an average of 3.24 with a standard deviation of 0.76, with positive skewness (0.05) and near-normal kurtosis (0.07). Other components such as "Curriculum and Objectives" (3.19) and "Use of Technology in the Classroom" (3.66) follow similar patterns, reflecting moderate effectiveness with varying distributions.

The main results of MANOVA will be discussed next. Table 2 shows the results of MANOVA. The results ($F(6, 193) = 15.12$, $p < .05$, partial $\eta^2 = .320$ representing a large effect size) indicated that there was a significant difference between male and female teachers' overall means on PSSQ. Thus; the first null-hypothesis as "there were not any significant differences in male and female's selection of problem-solving skills" was rejected.

Table 2

One-Sample T-Test Results for Hybrid Learning Model Validity

Component	Mean	Standard Deviation	t-Value	Significance Level	Mean Difference	Lower Bound	Upper Bound
External Validity	4.18	0.65	9.00	0.000	1.18	3.90	4.50
Objective	4.16	0.63	8.70	0.000	1.16	3.90	4.50
Research Design	4.23	0.70	9.10	0.000	1.23	3.90	4.60
Control of Confounding Variables	4.09	0.75	8.00	0.000	1.09	3.80	4.40
Adaptation	4.02	0.80	7.50	0.000	1.05	3.70	4.40
Internal Validity	4.33	0.60	9.50	0.000	1.33	4.00	4.70
Logical Review	4.11	0.75	8.27	0.000	1.11	3.80	4.50
Expert Feedback	4.27	0.60	9.20	0.000	1.27	4.00	4.60
Sensitivity Analysis	4.39	0.55	9.80	0.000	1.40	4.10	4.70

Table 2 provides the findings of the one-sample t-test used to assess the validity of the hybrid learning model. For the "External Validity" component, the average score is 4.18 with a standard deviation of 0.65. The calculated t-value of 9.00 is significant at a 0.000 level, confirming the high external validity of the model. Similarly, "Objective" has a mean of 4.16, with a t-value of 8.70, also showing high significance. The component "Research Design" yields a mean of 4.23 with a t-value of 9.10, further validating the design's appropriateness. All other components, including "Control of Confounding Variables" and "Internal Validity," display significant t-values, reinforcing the overall validity of the hybrid learning model.

Table 3

Priority Ranking of Hybrid Learning Components

Structure	Dimension	Factor Loading	Rank
Hybrid Learning	Quality Enhancement	0.753	3
Hybrid Learning	Improvement in Learning Quality	0.755	1
Hybrid Learning	Informal Learning	0.742	5
Hybrid Learning	Coding	0.745	4
Hybrid Learning	Responsiveness	0.748	3
Technological	Curriculum and Objectives	0.737	1
Technological	Use of Technology in the Classroom	0.732	2
Technological	Technology Skill Enhancement	0.724	3
Technological	Technology Environment	0.715	4
Pedagogical	Effective Teaching Methods	0.764	1
Pedagogical	Performance Evaluation	0.762	2
Pedagogical	Teacher Competence	0.759	3
Psychological	Attention and Motivation	0.781	2
Psychological	Selective Perception	0.776	3
Psychological	Retrieval	0.773	4
Psychological	Thinking	0.785	1

Table 3 ranks the components of hybrid learning based on their factor loadings. The "Psychological" dimension has the highest overall factor loading of 0.787, with "Thinking" ranking first within this dimension (factor loading of 0.785).

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The "Pedagogical" dimension follows closely with a factor loading of 0.768, where "Effective Teaching and Learning Methods" ranks highest (factor loading of 0.764). The "Technological" dimension, with a factor loading of 0.734, places "Curriculum and Objectives" as the top-ranked factor (loading of 0.737). Lastly, in the "Quality Enhancement" dimension, "Improvement in Learning Quality" ranks first with a factor loading of 0.755, underscoring its critical role in the hybrid learning framework.

Figure 1

Model with Standard Coefficients

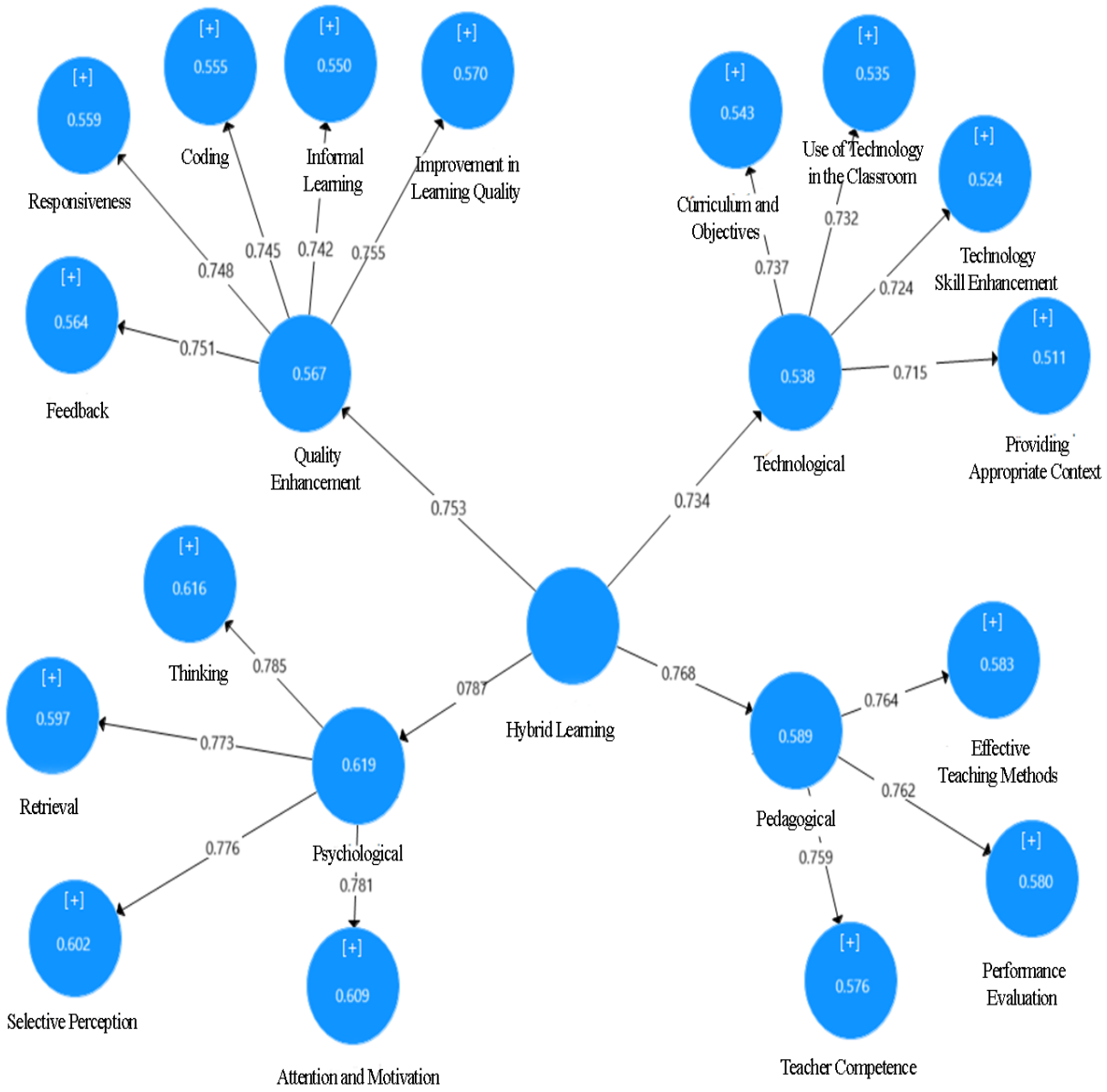

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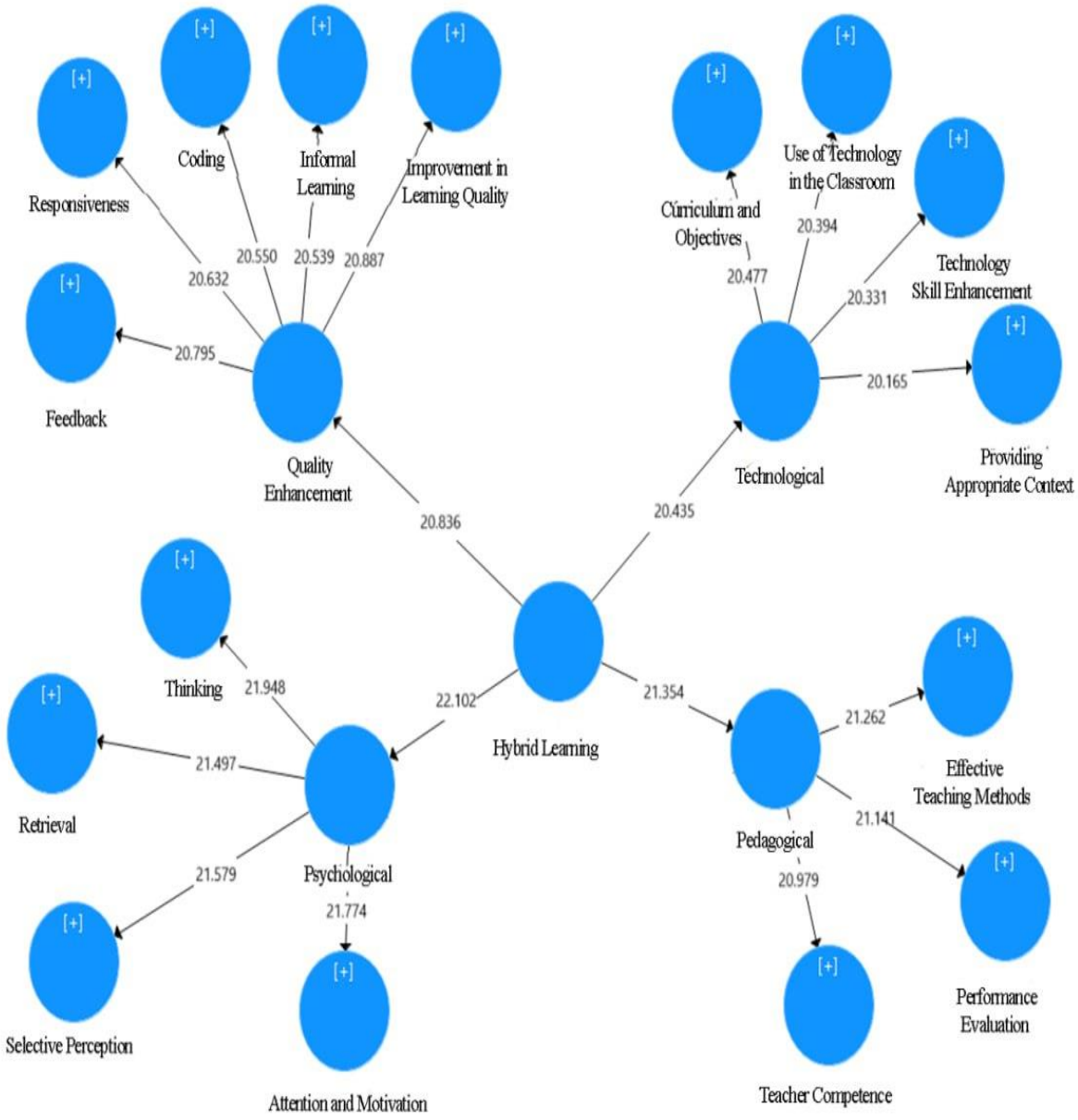
Figure 2

Model with T-values



4. Discussion and Conclusion

The results of this study demonstrate that the hybrid learning model designed for secondary education has significant potential for enhancing teaching and learning outcomes. The analysis of key components such as effective teaching methods, use of technology, student engagement, and learning outcomes revealed moderate to high levels of perceived effectiveness across various dimensions. The hybrid learning model was found to significantly contribute to improving the quality of learning, particularly through the integration of digital tools that support active engagement and provide flexible learning opportunities.

The findings align with previous research that highlights the advantages of hybrid learning in both academic performance and student satisfaction. A study by Ahlgren, Häkkinen, and Eskola (2020) identified similar success factors for hybrid teaching, emphasizing the role of clear communication and diverse instructional strategies in enhancing learning outcomes (Ahlgren et al., 2020). This is consistent with the results of the present study, which indicated that students in hybrid learning environments

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benefit from a combination of face-to-face interaction and online resources, enabling a more comprehensive understanding of course materials.

The positive effects of hybrid learning on student engagement were also evident in this study. Components such as "Attracting Attention and Motivation" and "Selective Perception" showed moderate effectiveness, suggesting that the hybrid model effectively captures students' interest and promotes active participation in the learning process. This supports findings from other studies, such as the work by Chukwuemeka-Nworu (2024), which highlighted the importance of hybrid learning in resource-scarce communities. In such settings, hybrid learning serves as a critical tool for keeping students engaged, particularly when access to traditional learning environments is limited (Chukwuemeka-Nworu, 2024).

The integration of technology in the classroom was another crucial factor identified in this study. The results indicated that students perceived the use of technology as an important element in enhancing their learning experiences. This aligns with the findings of Elfitra et al. (2022), who suggested that hybrid learning provides a viable alternative to fully online learning, offering a more balanced and effective approach to integrating technology into education (Elfitra et al., 2022). In particular, the use of digital tools such as e-learning platforms and multimedia resources was found to enhance student understanding and retention of information, as also reported by Gharib et al. (2016) in their qualitative study on promoting critical thinking through e-learning (Gharib et al., 2016).

However, while the hybrid learning model demonstrated overall effectiveness, some components, such as "Teacher Competence" and "Performance Evaluation," were found to have only moderate levels of perceived effectiveness. This suggests that there may still be challenges related to the readiness of educators to fully implement hybrid learning strategies. As noted by Farsi et al. (2021), the success of hybrid learning depends not only on the availability of technology but also on the ability of educators to effectively integrate digital tools into their teaching. Professional development and ongoing support for teachers are therefore essential to ensure that they can utilize the full potential of hybrid learning (Farsi et al., 2021).

Another important finding of this study is the role of hybrid learning in improving the quality of learning outcomes. The component "Improvement in Learning Quality" was ranked highly, indicating that students perceived hybrid learning as a valuable tool for enhancing their academic performance. This is supported by previous research, such as the meta-analysis conducted by Helsa, Turmudi, and Juandi (2023), which found that hybrid learning significantly improved students' conceptual understanding in subjects like mathematics (Helsa et al., 2023). Similarly, a study by Rahardjanto, Husamah, and Fauzi (2019) demonstrated that hybrid learning fosters the development of creative thinking skills and promotes higher levels of motivation among students (Rahardjanto et al., 2019).

Moreover, the findings related to "Curriculum and Objectives" suggest that hybrid learning offers a flexible and adaptable framework for achieving educational goals. This is consistent with the work of Köppe, Nørgård, and Pedersen (2017), who emphasized the importance of aligning hybrid learning strategies with curriculum objectives to maximize their effectiveness (Köppe et al., 2017). By providing students with multiple ways to engage with course content, hybrid learning allows for a more personalized and meaningful educational experience, as also highlighted by Goldstein et al. (2018) in their study on structuring hybrid learning activities (Goldstein et al., 2018).

One of the most significant contributions of hybrid learning is its ability to accommodate diverse learning styles and preferences. The results of this study showed that students with different learning needs, such as those who benefit from visual or auditory learning, were able to engage more effectively with the hybrid model. This supports the findings of Fransisca and Saputri (2023), who argued that hybrid learning allows for greater inclusivity by catering to a wide range of learning styles. By offering both online and face-to-face components, hybrid learning ensures that students can access materials in a way that best suits their individual needs (Fransisca & Saputri, 2023).

Despite these positive outcomes, the study also identified some limitations in the implementation of hybrid learning. For example, the component "Creating a Suitable Technology Environment" was rated moderately, indicating that there may still be challenges related to the infrastructure required for hybrid learning. This finding is consistent with the research of Müller (2022), who noted that technological infrastructure is a critical factor in determining the success of hybrid learning (Müller, 2021). In regions where access to reliable internet and digital devices is limited, the effectiveness of hybrid learning can be significantly hindered.

Overall, the results of this study demonstrate that hybrid learning has the potential to transform education by

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providing a flexible, engaging, and inclusive learning environment. However, the success of this model depends on several factors, including the readiness of educators, the availability of technological infrastructure, and the alignment of hybrid strategies with curriculum objectives. Future research should focus on addressing these challenges to further enhance the effectiveness of hybrid learning in secondary education.

While this study provides valuable insights into the effectiveness of hybrid learning in secondary education, there are several limitations that should be acknowledged. First, the study relied on self-reported data from the teachers' perspective, which may introduce biases related to perception of learning experiences. Although the use of a Likert scale questionnaire allowed for a standardized assessment of teachers' perceptions, self-report measures are inherently subjective and may not accurately reflect actual learning outcomes. Second, the study was conducted within a specific context in Iran, which may limit the generalizability of the findings to other regions or educational systems. The unique socio-economic and cultural factors in Iran may influence how hybrid learning is perceived and implemented, and the results may not fully apply to other countries with different educational infrastructures and policies.

In addition, the study focused primarily on teachers' perceptions of hybrid learning and did not include direct measures of academic performance, such as test scores or grades. Future research could benefit from incorporating objective measures of learning outcomes to provide a more comprehensive understanding of the effectiveness of hybrid learning. Finally, while this study explored the use of hybrid learning in secondary education, it did not account for differences in subject areas or grade levels.

Future research on hybrid learning should aim to address some of the limitations identified in this study. First, researchers should consider conducting longitudinal studies that track students' performance over time to assess the long-term impact of hybrid learning on academic outcomes. This would provide a more robust understanding of how hybrid learning influences student success beyond self-reported perceptions. Additionally, future studies should investigate the role of hybrid learning in different subject areas and grade levels to determine whether certain disciplines or age groups benefit more from this learning model. This would allow educators to tailor hybrid learning strategies to the specific needs of their students.

Moreover, future research should explore the impact of teacher training and professional development on the success of hybrid learning. As the findings of this study suggest, teacher competence is a critical factor in the effectiveness of hybrid learning, and more research is needed to identify best practices for preparing educators to integrate digital tools into their teaching. Finally, researchers should examine the role of technological infrastructure in hybrid learning, particularly in resource-scarce regions. By identifying the specific technological needs of schools and students, future studies can help inform policies that support the widespread adoption of hybrid learning.

To improve the implementation of hybrid learning in secondary education, several practical steps can be taken. First, it is essential to provide ongoing professional development for teachers to ensure that they are equipped with the necessary skills and knowledge to effectively integrate digital tools into their teaching. Schools should offer training programs that focus on the use of e-learning platforms, multimedia resources, and other technological tools that support hybrid learning. Additionally, educators should be encouraged to experiment with different instructional strategies to find the most effective methods for combining online and face-to-face learning.

Second, schools should invest in technological infrastructure to support the successful implementation of hybrid learning. This includes providing reliable internet access, ensuring that students have access to digital devices, and creating a suitable environment for the use of technology in the classroom. Schools should also work to establish clear guidelines and expectations for students regarding the use of online resources, helping them navigate the hybrid learning environment more effectively.

Finally, educators should focus on creating a flexible and inclusive curriculum that accommodates the diverse learning needs of students. By offering a variety of learning materials and activities that cater to different learning styles, teachers can ensure that all students have the opportunity to succeed in a hybrid learning environment. This includes providing opportunities for both independent study and collaborative learning, allowing students to engage with the content in ways that best suit their individual preferences.

Authors' Contributions

Authors equally contributed to this article.

Declaration

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In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

All procedures performed in studies involving human participants were under the ethical standards of the institutional and, or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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