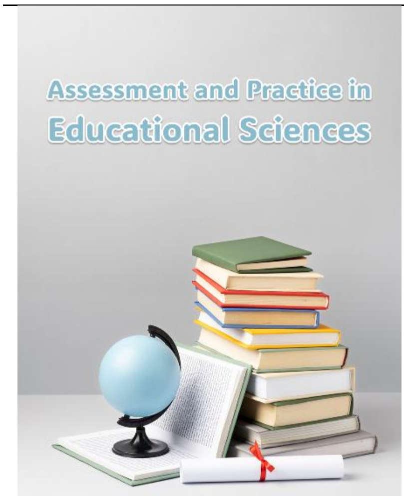
Assessment and Practice in Educational Sciences



Designing a Project-Based Curriculum Model in the Blended Learning System of the Second Cycle of Primary Education

ABSTRACT

The present study aimed to design a project-based curriculum model within the blended learning system of the second cycle of primary education. The qualitative findings of this study indicated that the core category of the research is "project-based learning in a blended learning system," which comprises three main components: (1) structural flexibility, (2) digital constructivism, and (3) learning in a real-world context. The quantitative findings also confirmed a good model fit, such that the indices $\chi^2/df < 3$, RMSEA = 0.06, CFI = 0.93, and GFI = 0.91 were validated. Furthermore, the composite reliability of the components exceeded 0.70, and convergent validity (AVE > 0.50) was at an acceptable level. The final model of the study indicates that the successful implementation of a project-based curriculum in a blended learning environment requires teacher empowerment, reform of the assessment system, strengthening of technological infrastructure, and redefining the teacher's role as a learning facilitator. The expected outcomes of this model include increased deep learning, creativity, responsibility, thinking skills, and a reduction in the gap between school and real-life contexts.

Keywords: Project-Based Curriculum, Blended Learning, Grounded Theory, Primary Education, Digital Constructivism

1. Mojtaba. Soltani: PhD Student, Department of Educational Sciences, Isl.C., Islamic Azad University, Islamshahr, Iran
2. Amirhosein. Mehdizadeh*: Department of Educational Sciences, Isl.C., Islamic Azad University, Islamshahr, Iran.
(Email: Amirhoseinmehdizadeh@iau.ac.ir)
3. Alireza. Araghieh: Department of Educational Sciences, Isl.C., Islamic Azad University, Islamshahr, Iran
4. Nahid. Shafiee: Department of Educational Sciences, Isl.C., Islamic Azad University, Islamshahr, Iran
5. Batoul. Faghih Aram: Department of Educational Sciences, Isl.C., Islamic Azad University, Islamshahr, Iran

Article type:
Original Research

Article history:
Received 25 December 2025
Revised 22 April 2026
Accepted 29 April 2026
Initial Publish 06 May 2026
Final Publish 01 September 2026

How to cite this article:
Soltani, M., Mehdizadeh, A., Araghieh, A., Shafiee, N., & Faghih Aram, B. (2026). Designing a Project-Based Curriculum Model in the Blended Learning System of the Second Cycle of Primary Education. *Assessment and Practice in Educational Sciences*, *4*(5), 1-21. https://doi.org/10.61838/japes.249

Introduction

The rapid transformation of contemporary education has brought curriculum design into renewed focus, particularly in relation to approaches that can bridge formal schooling with authentic life experiences, technological change, and the developmental needs of learners. In recent decades, the traditional curriculum model, which has often emphasized fragmented subject matter, teacher-centered delivery, and memorization-oriented assessment, has increasingly been criticized for its limited capacity to prepare students for the demands of complex, uncertain, and interconnected societies. Educational psychology and instructional theory have consistently emphasized that meaningful learning occurs when students actively construct knowledge, engage in inquiry, connect new information to prior experience, and apply understanding in purposeful contexts (1, 2). Within this framework, project-based learning has emerged as one of the most promising curriculum orientations because it reorganizes learning around real problems, collaborative inquiry, production of meaningful outcomes, and the integration of knowledge and skills across domains. At the same time, the growth of digital environments and the expansion of blended education have created new opportunities and new tensions in the design of learning experiences, particularly in primary education where developmental, pedagogical, and organizational factors interact in highly sensitive ways (3, 4). As a result, the need to conceptualize and design a project-based curriculum model suited to blended learning environments has become both theoretically significant and practically urgent.

Project-based learning is not merely a teaching technique; rather, it reflects a broader pedagogical philosophy in which learners encounter meaningful questions, investigate real or simulated problems, collaborate with peers, access diverse resources, and produce artifacts that demonstrate understanding. Research has shown that such an approach can strengthen deeper learning, student agency, motivation, cognitive flexibility, and performance when its design is pedagogically coherent and developmentally appropriate. Recent empirical evidence has reinforced these claims by demonstrating that project-based learning can improve academic performance, sustainable learning, creative thinking, metacognitive growth, and learning-to-learn competence (5-9). A literature review has also indicated that project-based learning contributes not only to cognitive development but also to social skills such as participation, cooperation, and responsibility, suggesting that its educational value extends beyond achievement indicators to encompass broader developmental outcomes (10). In the context of elementary education, these features are especially important because children in the second cycle of primary school are at a stage where curiosity, exploratory action, peer interaction, and concrete engagement with real-world issues can significantly enhance the quality and durability of learning.

Despite these potentials, the effective implementation of project-based learning depends heavily on curriculum structure. A curriculum cannot simply add projects to existing content-heavy routines and expect transformational outcomes. Instead, the logic of curriculum objectives, content organization, teaching methods, learning activities, assessment practices, technological resources, and educational environments must be aligned with the epistemological and pedagogical assumptions of project-based learning. Studies on project-based instruction have emphasized that success requires clear design requirements, sensitivity to learners' generational characteristics, supportive teacher roles, and reconfiguration of classroom processes from transmission to facilitation (2, 11). From this perspective, designing a project-based curriculum means constructing an integrated model in which content becomes interdisciplinary and flexible, learning activities become inquiry-oriented and problem-centered, and assessment moves beyond conventional testing toward process-based and performance-oriented approaches. Such a model requires not only instructional imagination but also systemic support and conceptual clarity regarding how learning should be organized in contemporary educational settings.

The rise of blended learning has made this challenge even more complex and more consequential. Blended learning is commonly understood as the purposeful integration of face-to-face and digital learning experiences in ways that expand access, flexibility, interactivity, and personalization. However, blended learning is not educationally meaningful simply because digital tools are introduced into teaching. Its effectiveness depends on how pedagogy, content, interaction, assessment, and technology are coordinated. The global disruption caused by the COVID-19 pandemic accelerated the adoption of online and blended learning across educational systems and exposed both the possibilities and weaknesses of existing curricula. Distance education was widely used as an emergency response, yet the experience also revealed cultural, organizational, pedagogical, and technological issues that continue to shape post-pandemic educational reform (3). In many contexts, virtual education created opportunities for expanded access, resource diversification, and digital skill development, while simultaneously highlighting serious concerns such as unequal access, reduced interaction quality, inadequate infrastructure, insufficient teacher preparation, and assessment difficulties (12-15). These tensions suggest that the future of blended learning depends not only on technology adoption but on the redesign of curriculum models that can preserve human interaction, deepen inquiry, and support authentic engagement.

Within blended environments, project-based learning appears particularly promising because its central features align well with the affordances of digital and hybrid instruction. Digital platforms can support collaboration, documentation, feedback, access to diverse information sources, and the creation of multimodal products. National and smart learning platforms, for example, have been shown to support project-based learning by extending learning opportunities beyond conventional classroom hours and enabling activity-rich instructional ecosystems (16). Emerging technologies such as digital twins and advanced interactive environments further demonstrate the capacity of blended systems to enrich educational experiences through simulation, flexibility, and real-time adaptation (4). At the same time, the use of technology in a project-based curriculum should not be reduced to technical efficiency alone. Rather, technology must be understood as part of a constructivist learning architecture in which students investigate, communicate, reflect, revise, and present ideas in meaningful ways. When digital environments are integrated pedagogically, they can support student-centered inquiry, foster metacognitive regulation, and create bridges between school learning and the wider world (6, 7). Therefore, the problem is not whether blended learning should be used, but how it should be structured pedagogically to achieve deep and sustainable learning.

In the second cycle of primary education, this issue is particularly important. Learners at this stage are transitioning toward more complex cognitive operations, stronger peer orientation, greater independence in task engagement, and more explicit connections between school knowledge and everyday life. Curriculum design for this age group must therefore address both developmental appropriateness and future-oriented competencies. A project-based approach in blended education can potentially respond to this need by combining guided inquiry, collaborative exploration, and flexible use of digital tools with real-life problem solving. Such a curriculum can foster creativity, critical thinking, self-confidence, communication, and decision-making in ways that traditional approaches often fail to achieve (1, 5, 8). Moreover, positive and supportive teaching environments are essential in enabling students to participate actively and confidently in these kinds of learning processes, since productive learning depends not only on task design but on the emotional and relational climate created by teachers (17). This means that any model of project-based curriculum in blended learning must also pay attention to the quality of interaction, the facilitative role of teachers, and the creation of responsive learning spaces.

Nevertheless, the implementation of such a model faces substantial barriers in practice. Research on virtual and blended education has repeatedly shown that teachers often encounter difficulty adapting to new roles, managing digital platforms, sustaining meaningful interaction, and conducting appropriate assessment in hybrid contexts (12, 14, 18). The lived experiences of teachers during and after the pandemic underscore that assessment in blended education requires rethinking conventional procedures and moving toward more applied, continuous, and context-sensitive models (18). At the same time, infrastructural limitations, unequal access to devices and connectivity, and lack of institutional support continue to hinder effective implementation (13, 15). In many educational systems, these challenges are intensified by centralized curricula, textbook-driven instruction, and assessment systems that privilege content recall over inquiry, performance, and reflection. Under such conditions, project-based learning may be adopted superficially or episodically, without being embedded in the formal curriculum structure. This creates a gap between the rhetoric of innovation and the realities of educational practice.

Another important issue concerns the conceptual relationship between curriculum and extracurricular learning experiences. Integrating project-based learning into formal schooling requires moving beyond the traditional separation between official curriculum content and experiential, participatory, or extracurricular activities. Theoretical work on curriculum integration has argued that curriculum should be understood more holistically, in ways that connect formal learning goals with real-life engagement, interdisciplinary participation, and broader developmental experiences (19). This perspective is especially relevant to project-based curricula because projects often require field inquiry, practical production, collaboration, and problem-solving that do not fit neatly within narrow subject boundaries or rigid classroom routines. Therefore, designing a project-based curriculum for blended learning requires not only methodological revision but a conceptual expansion of what counts as curriculum, how learning is sequenced, and how formal and informal dimensions of learning are interwoven.

The current research context further justifies the need for model design. While previous studies have documented the opportunities and challenges of virtual education, examined teaching-learning interaction in online environments, explored requirements for project-based instruction, and analyzed the effects of project-based learning on achievement and higher-order skills, fewer studies have attempted to construct a comprehensive curriculum model that systematically organizes these insights for the second cycle of primary education within a blended system (8, 11, 13, 14). Much of the available literature tends either to focus on one instructional variable, such as creativity or metacognition, or to examine emergency virtual education rather than pedagogically designed blended learning. In addition, some studies focus on secondary or higher education contexts, leaving the primary level relatively under-theorized, despite its strategic importance for shaping long-term dispositions toward inquiry, collaboration, and autonomous learning (5, 10). This indicates a clear gap in the literature regarding the design of a contextually grounded and empirically validated project-based curriculum model suitable for blended elementary education.

A well-designed model in this area can provide multiple contributions. Theoretically, it can clarify the core dimensions that must be aligned for project-based blended learning to function as a coherent curriculum paradigm rather than as an isolated pedagogical tactic. Practically, it can help policymakers, curriculum planners, school leaders, and teachers understand how goals, content, teaching methods, assessment, technology, learning spaces, and learning activities can be restructured in relation to one another. Such a model can also identify the facilitating conditions and barriers that shape implementation, thereby making reform efforts more realistic and context-sensitive. In light of rapid technological development, shifting educational expectations, and increasing emphasis on 21st-century competencies, curriculum design can no longer remain confined to static content transmission; it must enable students to inquire, create, collaborate, adapt, and act meaningfully in both physical and digital environments (6, 9, 16). At the same time, pedagogical coherence remains essential: without careful curriculum design, technology can amplify fragmentation rather than integration, and projects can become superficial tasks rather than vehicles for genuine intellectual growth.

Accordingly, the present study was conducted to design a project-based curriculum model in the blended learning system of the second cycle of primary education.

Methods and Materials

This study was applied in terms of purpose and employed an exploratory mixed-methods design integrating both qualitative and quantitative approaches. In the qualitative phase, the study followed the grounded theory methodology to develop a conceptual model, while the quantitative phase was conducted using a cross-sectional survey design to validate the proposed model. In the qualitative section, a comprehensive review of theoretical literature, prior research, and scientific documents relevant to project-based curriculum and blended learning systems was undertaken. Relevant sources were retained based on the research objectives, and unrelated materials were excluded through a systematic screening process. To enhance the rigor of the literature search, an independent researcher with expertise in information retrieval methods conducted a parallel search to ensure completeness and accuracy. In addition to document analysis, data were collected through semi-structured exploratory interviews with experts who possessed theoretical, practical, and professional experience in primary education, particularly in project-based curriculum design and blended learning systems. These interviews were conducted iteratively and continued until theoretical saturation was achieved, which occurred after ten expert participants.

In the quantitative phase, the statistical population consisted of 300 participants, including educational experts, school administrators, and primary school teachers. Additionally, a group of 30 curriculum planning specialists and experts participated in validating the proposed curriculum model. The selection of participants in both phases was purposive in the qualitative stage and more inclusive in the quantitative stage to ensure adequate representation of stakeholders involved in primary education and curriculum implementation.

In the qualitative phase, multiple data collection tools were employed to ensure methodological triangulation and enhance the credibility of findings. Semi-structured exploratory interviews served as the primary data collection method, guided by a set of predefined but flexible questions that allowed participants to elaborate on their experiences and perspectives. The interviews were recorded, transcribed into textual data, and systematically analyzed. In addition, document analysis was used as a complementary strategy to enrich the dataset and provide contextual depth. The process of data collection in the qualitative phase also involved several stages of coding, including initial (open) coding to extract primary concepts from raw data, focused coding to group similar concepts into categories, axial coding to identify relationships among categories, and selective coding to determine the core category that integrates all other categories within the theoretical framework.

In the quantitative phase, two researcher-developed questionnaires were used. The first questionnaire consisted of closed-ended items measured on a five-point Likert scale and was designed to assess the identified components of the project-based curriculum model in a blended learning system. The second questionnaire was specifically developed to evaluate the degree of fit and appropriateness of the proposed model. To ensure the validity of the instruments, face validity and content validity were assessed and confirmed by subject matter experts and academic specialists. Construct validity was further examined through internal consistency measures, including the correlation of subscales with the total score. Reliability of the qualitative instruments was established through triangulation techniques, as recommended by John W. Creswell (2014), which involved combining multiple data sources and methods. Additionally, inter-rater reliability for qualitative coding was assessed using Cohen’s kappa coefficient. In the quantitative phase, reliability was evaluated using Cronbach’s alpha coefficient to assess the internal consistency of the questionnaires and their subscales.

Data analysis in the qualitative phase followed the systematic procedures of grounded theory. After transcription, the interview data were segmented into meaningful units and subjected to open coding to identify initial concepts. These concepts were then compared and refined through constant comparative analysis, leading to the development of categories during the axial coding phase. Relationships among categories were identified, and their dimensions were clarified. In the final stage of selective coding, a core category was determined, integrating all categories into a coherent theoretical model that explains project-based learning within a blended learning system.

In the quantitative phase, data analysis was conducted using descriptive and inferential statistical methods. Descriptive statistics were used to summarize participants' responses and characterize the variables under study. Inferential analysis was employed to evaluate the fit of the proposed model, including structural equation modeling and goodness-of-fit indices. The adequacy of the model was assessed using indices such as chi-square to degrees of freedom ratio (χ^2/df), root mean square error of approximation (RMSEA), comparative fit index (CFI), and goodness-of-fit index (GFI). Additionally, composite reliability and average variance extracted (AVE) were calculated to assess the reliability and convergent validity of the model constructs. These analytical procedures ensured that both the theoretical model derived from the qualitative phase and its empirical validation in the quantitative phase were robust, reliable, and scientifically sound.

Findings and Results

In the qualitative data analysis, through staged coding procedures including open, axial, and selective coding, and complemented by quantitative validation analyses, a final paradigmatic structure was achieved that can conceptually be termed the "project-based model in the context of blended learning." The summary of the main findings is as follows.

The core category (final paradigm) was identified as project-based learning in the context of blended learning. In other words, the proposed model represents a transformative paradigm that relies on the simultaneity of three key components: structural flexibility, digital constructivism, and learning in a real-world context. Structural flexibility refers to adaptability to various conditions, including flexibility in time, grouping, and organization of activities. Digital constructivism involves the integration of constructivist approaches with digital tools and emerging technologies such as learning management systems, artificial intelligence, and interactive realities. Learning in a real-world context emphasizes the design of projects targeting real and interdisciplinary problems, thereby connecting learning to practical application.

In the quantitative phase, the conceptual model derived from the qualitative findings was tested using confirmatory factor analysis. The results indicated that the model fit indices were at an acceptable level, demonstrating a good fit between the model and the data. In addition, composite reliability and convergent validity ($AVE > 0.50$) for the components were confirmed. Therefore, it can be concluded that the final model possesses sufficient conceptual and statistical validity, and the relationships among the extracted components are logical and consistent with the empirical data.

The characteristics of the curriculum elements were designed as follows. The program objectives emphasize skill-based and life-oriented learning, with dynamic, participatory goals focused on fostering creativity and problem-solving competencies. The content is fluid and interdisciplinary, reducing the volume of rote material and focusing on depth of learning and integration across subjects. Teaching methods are based on guided inquiry learning, where the teacher acts as a facilitator of the research process and the student is positioned at the center of project design and implementation. Learning activities consist of multidimensional project-based tasks including data collection, analysis, product creation, presentation, and feedback, with emphasis on teamwork, inquiry, field research, and problem-solving approaches. Evaluation follows a process-oriented and formative approach, utilizing digital portfolios, self-assessment, peer assessment, and performance-based evaluation instead of purely content-based tests. Technology and resources involve the integration of digital technologies, content production tools, project management tools, and at advanced levels, artificial intelligence and virtual reality, to facilitate learning, enable open access to resources, and support digital documentation of the learning process. Learning environments are designed as dynamic and flexible spaces, including technology-based learning centers, modular libraries, and blended physical-virtual environments that enable the implementation of practical and interdisciplinary projects.

The findings regarding the current status of the second cycle of primary education curriculum, in terms of attention to project-based approaches within a blended learning system, revealed several dimensions. The underlying causes for the need for such a model include societal and labor market demands for 21st-century skills, the gap between traditional education systems and real-life contexts, and technological advancements in education. Intervening conditions include both facilitating and inhibiting factors; access to technology and its acceptance, along with managerial and cultural support, act as facilitators, whereas teacher resistance to role change, lack of financial and equipment resources, and centralized evaluation systems were identified as major barriers. Proposed strategies include designing and implementing interdisciplinary projects, training and empowering teachers in their role as facilitators, transforming educational environments into technology-based centers, and implementing process-oriented evaluation mechanisms such as digital portfolios, self-assessment, and peer assessment.

Initially, the results obtained from the qualitative phase for each dimension and its components were analyzed and validated. Finally, the main model derived from the analyses was illustrated, and its corresponding model fit was reported.

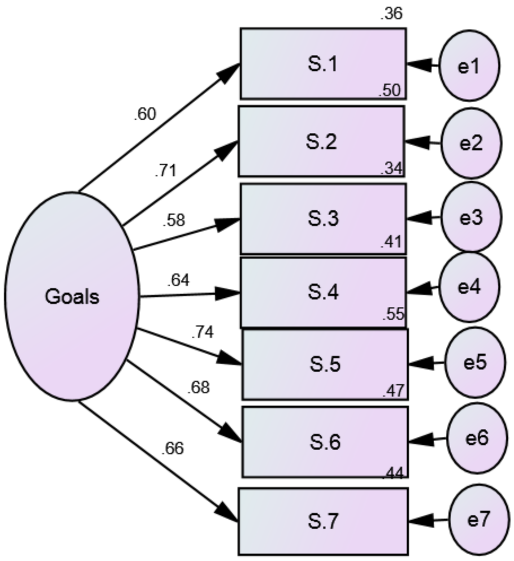


Figure 1. Fitted Model of Objectives and Philosophy

The structural fit of the “objectives and philosophy” dimension was examined. In the qualitative phase, seven components were identified for this dimension, and confirmatory factor analysis using quantitative data confirmed the model fit. Examination of the model with empirical data showed that the path coefficients were statistically significant at the 0.05 level. Based on the obtained results, the model related to objectives and philosophy with seven components was confirmed. The model fit indices are presented below.

Table 1. Model Fit Indices for Objectives and Philosophy

Fit Indices	χ^2	df	p	χ^2/df	GFI	IFI	TLI	CFI	RMSEA
Observed Values	33.98	14	0.002	2.40	0.975	0.976	0.964	0.976	0.06

According to Table 1, the values obtained for GFI, IFI, TLI, and CFI are all above 0.90, and RMSEA is equal to 0.06. These values indicate an acceptable fit of the structural model for objectives and philosophy.

The significance of the objectives and philosophy dimension was also examined. The mean, standard deviation, and results of the one-sample t-test for this dimension are presented below. The findings indicate that the mean values of the objectives and philosophy and their components are significantly higher than the theoretical mean at the 0.05 significance level.

Table 2. One-Sample t-Test Results for Objectives and Philosophy

Components	Mean	SD	t	df	Sig
Objectives and Philosophy (Total)	4.77	0.38	92.97	396	0.001
Solving Real Problems	4.77	0.48	73.31	396	0.001
Preparing Independent, Creative, and Critical Thinkers	4.78	0.49	72.40	396	0.001
Developing Self-Confidence	4.78	0.44	79.98	396	0.001
Developing Decision-Making Skills	4.78	0.45	79.16	396	0.001
Developing Problem-Solving Skills	4.77	0.50	70.87	396	0.001
Emphasis on Deep and Lifelong Learning	4.76	0.53	65.79	396	0.001
Solving Applied Problems	4.77	0.50	70.87	396	0.001

The results presented in Table 2 show that, in the objectives and philosophy dimension, all weighted mean values are statistically significant. Accordingly, administrators and teachers considered the identified components to be necessary and important.

The structural fit of the "content" dimension was also examined. In the qualitative phase, seven components were identified for content, and confirmatory factor analysis using quantitative data confirmed the model fit.

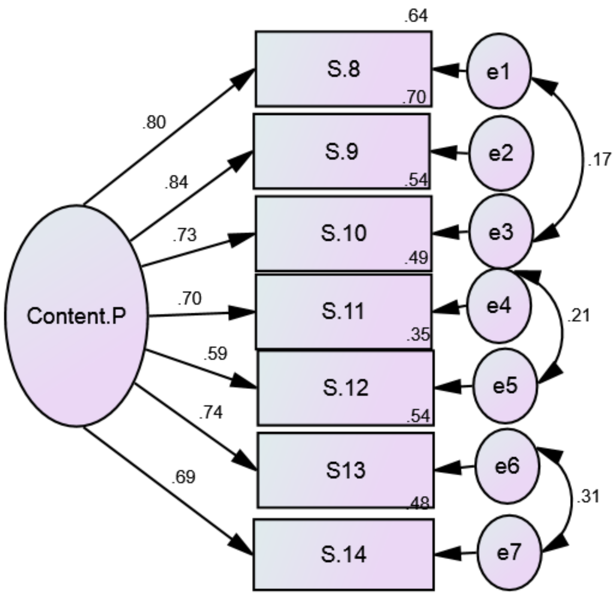


Figure 2. Fitted Model of Content

Examination of the model with empirical data indicated that path coefficients were significant at the 0.05 level. Based on the results, the model related to content with seven components was confirmed. The model fit indices are presented below.

Table 3. Model Fit Indices for Content

Fit Indices	χ^2	df	p	χ^2/df	GFI	IFI	TLI	CFI	RMSEA
Observed Values	17.53	11	0.093	1.50	0.988	0.995	0.991	0.995	0.03

According to Table 3, the values obtained for GFI, IFI, TLI, and CFI are all above 0.90, and RMSEA is equal to 0.03. These results indicate that the structural model for content demonstrates a satisfactory level of fit.

The table below presents the mean, standard deviation, and results of the one-sample t-test for examining the significance of the content dimension. Based on the obtained results, the mean values of content and its components are significantly higher than the theoretical mean at the 0.05 significance level.

Table 4. One-Sample t-Test for Content

Components	Mean	SD	t	df	Sig
Content (Total)	4.78	0.37	95.60	396	0.001

Activity-Based Content	4.76	0.52	67.35	396	0.001
Challenging Content	4.73	0.56	62.07	396	0.001
Interdisciplinary Content	4.74	0.52	67.44	396	0.001
Aligned with Learners' Interests	4.79	0.44	81.86	396	0.001
Related to Real Life	4.83	0.40	92.20	396	0.001
Flexible Content	4.82	0.42	86.63	396	0.001
Stimulating Curiosity and Inquiry	4.77	0.46	76.70	396	0.001

The results presented in Table 4 indicate that, in the content dimension, all weighted mean values are statistically significant. Accordingly, administrators and teachers considered the identified components to be necessary and important.

The structural fit of the teaching methods dimension was examined. In the qualitative phase, seven components were identified for teaching methods, and confirmatory factor analysis using quantitative data confirmed the model fit. The model and its fit are presented below.

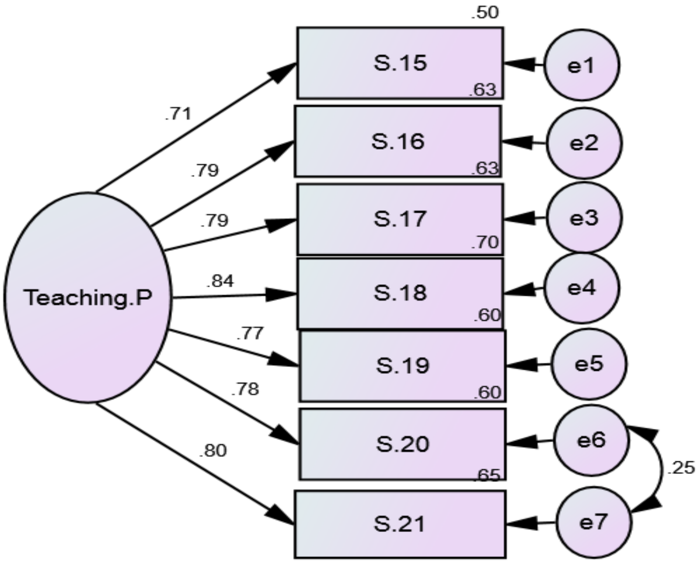


Figure 3. Fitted Model of Teaching Methods

Examination of the model using empirical data indicates that the path coefficients are significant at the 0.05 level. Based on the obtained results, the model related to teaching methods with seven components was confirmed. The model fit indices are presented below.

Table 5. Model Fit Indices for Teaching Methods

Fit Indices	χ^2	df	p	χ^2/df	GFI	IFI	TLI	CFI	RMSEA
Observed Values	27.43	12	0.007	2.20	0.980	0.991	0.985	0.991	0.05

According to Table 5, the values obtained for GFI, IFI, TLI, and CFI are all above 0.90, and RMSEA is equal to 0.05. These values indicate a good level of fit for the structural model of teaching methods.

The significance of the teaching methods dimension was also examined. The table below presents the mean, standard deviation, and results of the one-sample t-test for this dimension. Based on the results, the mean values of teaching methods and their components are significantly higher than the theoretical mean at the 0.05 significance level.

Table 6. One-Sample t-Test for Teaching Methods

Components	Mean	SD	t	df	Sig
Teaching Methods (Total)	4.77	0.40	89.04	396	0.001
Student-Centered Approach	4.84	0.37	98.15	396	0.001

Facilitating Role	4.70	0.64	53.18	396	0.001
Teacher as Guide	4.74	0.52	66.44	396	0.001
Collaborative and Group-Based Learning	4.78	0.47	75.49	396	0.001
Inquiry-Based Method	4.81	0.44	81.92	396	0.001
Problem-Solving Method	4.76	0.50	70.42	396	0.001
Dialogic and Investigative Method	4.78	0.43	81.87	396	0.001

The results presented in Table 6 indicate that, in the teaching methods dimension, all weighted mean values are statistically significant. Accordingly, administrators and teachers considered the identified components to be necessary and important.

The structural fit of the evaluation dimension was examined. In the qualitative phase, nine components were identified for evaluation, and confirmatory factor analysis using quantitative data confirmed the model fit. The model and its fit are presented below.

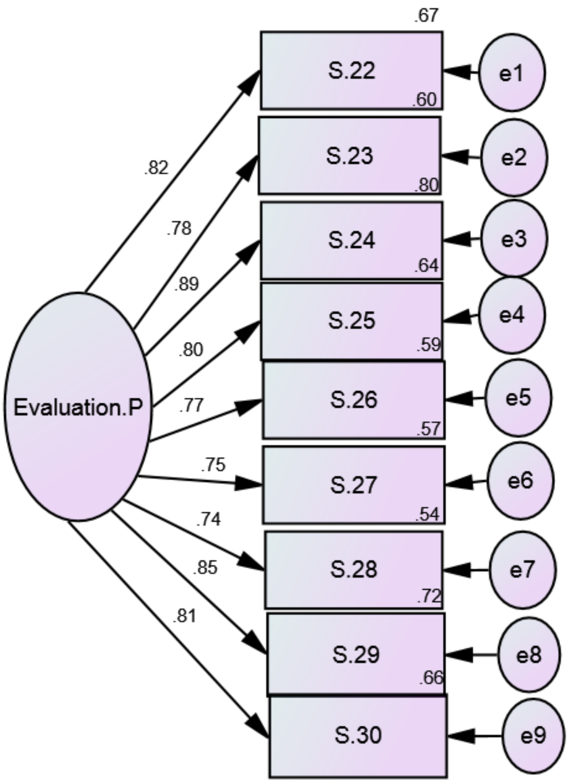


Figure 4. Fitted Model of Evaluation

Examination of the model using empirical data indicates that the path coefficients are significant at the 0.05 level. Based on the obtained results, the model related to evaluation with nine components was confirmed. The model fit indices are presented below.

Table 7. Model Fit Indices for Evaluation

Fit Indices	χ^2	df	p	χ^2/df	GFI	IFI	TLI	CFI	RMSEA
Observed Values	60.85	24	0.001	2.50	0.962	0.979	0.968	0.978	0.06

According to Table 7, the values obtained for GFI, IFI, TLI, and CFI are all above 0.90, and RMSEA is equal to 0.06. These values indicate an acceptable fit for the structural model of evaluation.

The significance of the evaluation dimension was also examined. The table below presents the mean, standard deviation, and results of the one-sample t-test for this dimension. Based on the results, the mean values of evaluation and their components are significantly higher than the theoretical mean at the 0.05 significance level.

Table 8. One-Sample t-Test for Evaluation

Components	Mean	SD	t	df	Sig
Evaluation (Total)	4.74	0.45	76.50	396	0.001
Continuous Assessment	4.79	0.45	78.58	396	0.001
Performance-Based Assessment	4.76	0.51	69.03	396	0.001
Beyond Traditional Assessment	4.77	0.51	69.36	396	0.001
Self-Assessment	4.77	0.52	68.15	396	0.001
Peer Assessment	4.76	0.51	68.63	396	0.001
Use of Portfolio	4.71	0.60	57.07	396	0.001
Comprehensive Assessment of Thinking Skills	4.63	0.76	42.55	396	0.001
Comprehensive Assessment of Problem-Solving Skills	4.75	0.65	64.04	396	0.001
Comprehensive Assessment of Collaboration Skills	4.74	0.55	62.92	396	0.001

The results presented in Table 8 indicate that, in the evaluation dimension, all weighted mean values are statistically significant. Accordingly, administrators and teachers considered the identified components to be necessary and important.

The structural fit of the technology dimension was examined. In the qualitative phase, five components were identified for technology, and confirmatory factor analysis using quantitative data confirmed the model fit. The model and its fit are presented below.

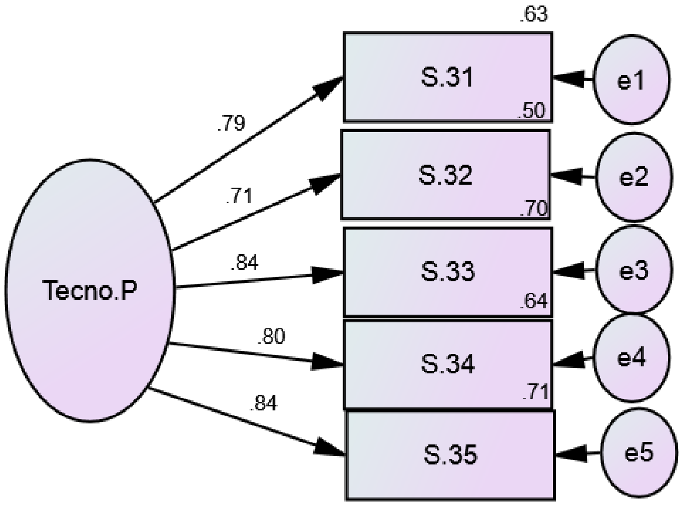


Figure 5. Fitted Model of Technology

Examination of the model using empirical data indicates that the path coefficients are significant at the 0.05 level. Based on the obtained results, the model related to technology with five components was confirmed. The model fit indices are presented below.

Table 9. Model Fit Indices for Technology

Fit Indices	χ^2	df	p	χ^2/df	GFI	IFI	TLI	CFI	RMSEA
Observed Values	11.21	5	0.047	2.20	0.989	0.994	0.989	0.994	0.05

According to Table 9, the values obtained for GFI, IFI, TLI, and CFI are all above 0.90, and RMSEA is equal to 0.05. These values indicate an acceptable fit for the structural model of technology.

The significance of the technology dimension was also examined. The table below presents the mean, standard deviation, and results of the one-sample t-test for this dimension. Based on the results, the mean values of technology and its components are significantly higher than the theoretical mean at the 0.05 significance level.

Table 10. One-Sample t-Test for Technology

Components	Mean	SD	t	df	Sig
Technology (Total)	4.73	0.46	75.58	396	0.001
Use of Augmented and Digital Reality	4.75	0.52	67.83	396	0.001
Facilitating Access to Diverse Resources	4.73	0.56	62.07	396	0.001
Personalization of the Learning Process	4.74	0.52	67.19	396	0.001
Online Collaboration Platform for Projects	4.70	0.57	59.64	396	0.001
Group Communication Platform for Projects	4.71	0.56	61.56	396	0.001

The results presented in Table 10 indicate that, in the technology dimension, all weighted mean values are statistically significant. Accordingly, administrators and teachers considered the identified components to be necessary and important.

In the qualitative phase, seven components were identified for learning activities. Using quantitative data, confirmatory factor analysis was conducted to examine these components, and the model fit was confirmed. The model and its fit are presented below.

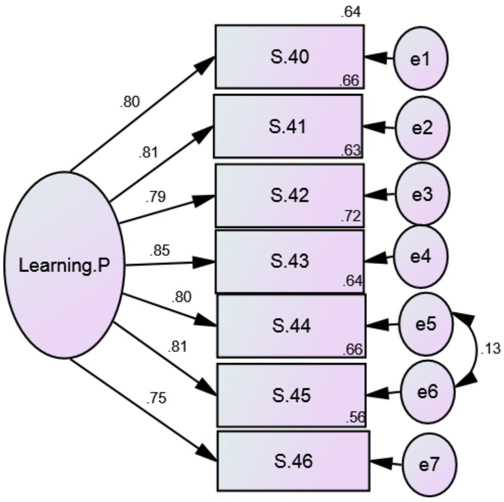


Figure 6. Fitted Model of Learning Activities

Examination of the model using empirical data indicates that the path coefficients are significant at the 0.05 alpha level. Based on the obtained results, the model related to learning activities with seven components was confirmed. The model fit indices are presented below.

Table 11. Model Fit Indices for Learning Activities

Fit Indices	χ^2	df	p	χ^2/df	GFI	IFI	TLI	CFI	RMSEA
Observed values	28.36	13	0.008	2.10	0.980	0.992	0.986	0.992	0.05

According to Table 11, the obtained values for GFI, IFI, TLI, and CFI are all above 0.90, and the RMSEA value is 0.05. These results indicate a very good fit for the structural model of learning activities.

The significance of learning activities was also examined. The table below presents the mean, standard deviation, and results of the one-sample t-test for assessing the significance of learning activities. Based on the obtained results, the mean of learning activities and its components is significantly higher than the theoretical mean at the 0.05 alpha level.

Table 12. One-Sample t-Test for Learning Activities

Components	Mean	SD	t	df	Sig.
Learning Activities (Total)	4.80	0.37	96.03	396	0.001
Practical Learning Activities	4.79	0.43	83.19	396	0.001
Collaborative Learning Activities	4.81	0.44	82.83	396	0.001

Encouraging Creative Thinking	4.79	0.48	74.51	396	0.001
Research-Based	4.82	0.42	86.44	396	0.001
Encouraging the Presentation of Innovative Solutions	4.80	0.47	76.43	396	0.001
Contributing to the Development of Managerial Skills	4.80	0.45	80.45	396	0.001
Developing Entrepreneurial Skills	4.78	0.79	73.17	396	0.001

The results presented in Table 12 indicate that, in the dimension of learning activities, all weighted mean values are statistically significant. Accordingly, principals and teachers considered the identified components necessary and important.

The structural fit of the educational space dimension was examined. In the qualitative phase, four components were identified for educational space. Using quantitative data, confirmatory factor analysis was conducted to examine these components, and the model fit was confirmed. The model and its fit are presented below.

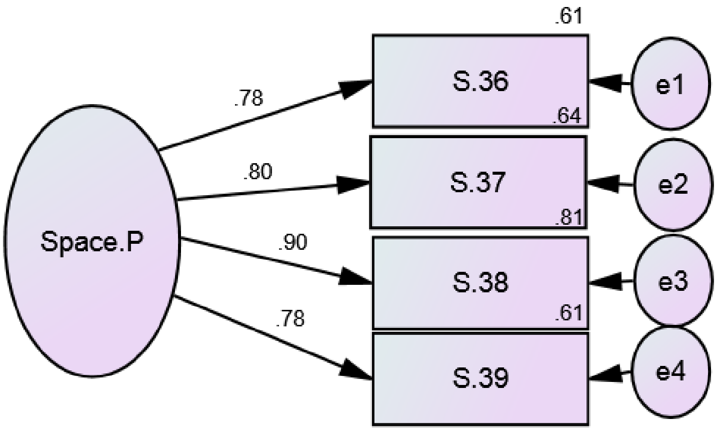


Figure 7. Fitted Model of Educational Space

Examination of the model using empirical data indicates that the path coefficients are significant at the 0.05 alpha level. Based on the obtained results, the model related to educational space with four components was confirmed. The model fit indices are presented below.

Table 13. Model Fit Indices for Educational Space

Fit Indices	χ^2	df	p	χ^2/df	GFI	IFI	TLI	CFI	RMSEA
Observed values	3.35	2	0.187	1.67	0.996	0.998	0.995	0.998	0.04

According to Table 13, the obtained values for GFI, IFI, TLI, and CFI are all above 0.90, and the RMSEA value is 0.04. These results indicate a very good fit for the structural model of educational space.

The significance of educational space was also examined. The table below presents the mean, standard deviation, and results of the one-sample t-test for assessing the significance of educational space. Based on the obtained results, the mean of educational space and its components is significantly higher than the theoretical mean at the 0.05 alpha level.

Table 14. One-Sample t-Test for Educational Space

Components	Mean	SD	t	df	Sig.
Educational Space (Total)	4.80	0.38	94.20	396	0.001
Flexible and Adaptable Space	4.79	0.47	75.84	396	0.001
Space Supporting Group and Practical Projects	4.78	0.48	74.45	396	0.001
Possibility of Access to Diverse Spaces	4.83	0.39	92.44	396	0.001
Space Equipped with Technological Facilities	4.83	0.42	87.51	396	0.001

The results presented in Table 14 indicate that, in the dimension of educational space, all weighted mean values are statistically significant. Accordingly, principals and teachers considered the identified components necessary and important.

The structural fit of the challenges and drawbacks dimension was examined. In the qualitative phase, five components were identified for challenges and drawbacks. Using quantitative data, confirmatory factor analysis was conducted to examine these components, and the model fit was confirmed. The model and its fit are presented below.

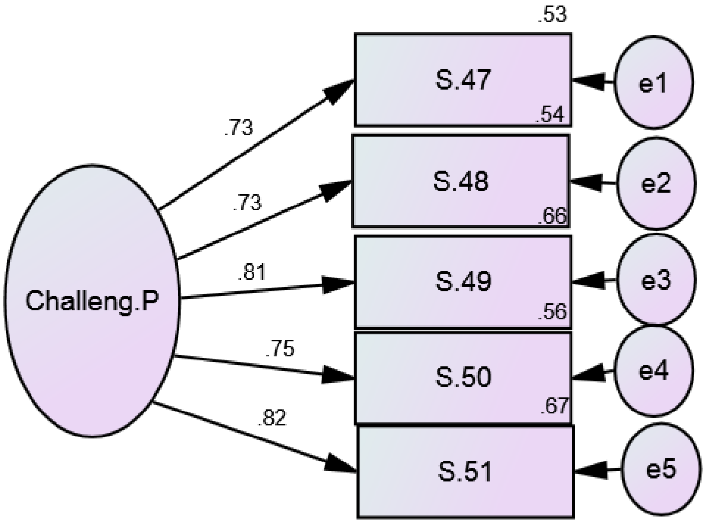


Figure 8. Fitted Model of Challenges and Drawbacks

Examination of the model using empirical data indicates that the path coefficients are significant at the 0.05 alpha level. Based on the obtained results, the model related to challenges and drawbacks with five components was confirmed. The model fit indices are presented below.

Table 15. Model Fit Indices for Challenges and Drawbacks

Fit Indices	χ^2	df	p	χ^2/df	GFI	IFI	TLI	CFI	RMSEA
Observed values	3.99	5	0.551	0.798	0.975	1.00	1.00	1.00	0.00

According to Table 15, the obtained values for GFI, IFI, TLI, and CFI are all above 0.90, and the RMSEA value is 0.00. These results indicate an excellent fit for the structural model of challenges and drawbacks.

The significance of challenges and drawbacks was also examined. The table below presents the mean, standard deviation, and results of the one-sample t-test for assessing the significance of challenges and drawbacks. Based on the obtained results, the mean of challenges and drawbacks and its components is significantly higher than the theoretical mean at the 0.05 alpha level.

Table 16. One-Sample t-Test for Challenges and Drawbacks

Components	Mean	SD	t	df	Sig.
Challenges and Drawbacks (Total)	4.72	0.46	75.43	396	0.001
Predominance of the Traditional Approach	4.76	0.50	70.00	396	0.001
Lack of Facilities and Infrastructural Constraints	4.73	0.58	59.68	396	0.001
Teachers' Skill weakness in Effective Project Implementation	4.68	0.61	55.14	396	0.001
Very Weak Implementation of the Project-Based Program	4.73	0.55	62.59	396	0.001
Weakness of Resources Required for Effective Project Implementation	4.72	0.54	63.55	396	0.001

The results presented in Table 16 indicate that, in the dimension of learning activities, all weighted mean values are statistically significant. Accordingly, principals and teachers considered the identified components necessary and important.

The structural fit of the outcomes dimension was examined. In the qualitative phase, four components were identified for outcomes. Using quantitative data, confirmatory factor analysis was conducted to examine these components, and the model fit was confirmed. The model and its fit are presented below.

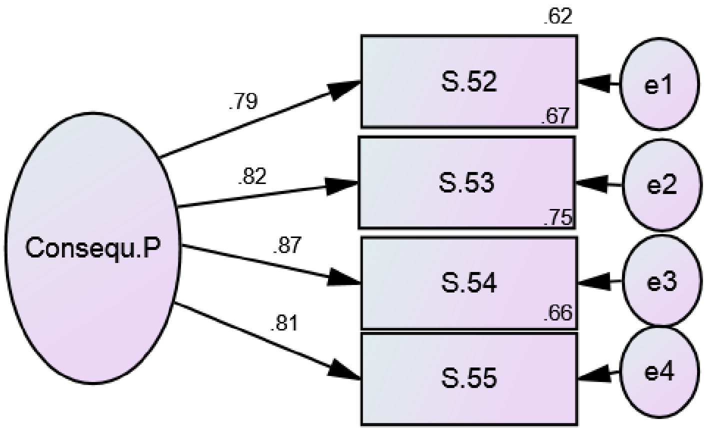


Figure 9. Fitted Model of Outcomes

Examination of the model using empirical data indicates that the path coefficients are significant at the 0.05 alpha level. Based on the obtained results, the model related to outcomes with four components was confirmed. The model fit indices are presented below.

Table 17. Model Fit Indices for Outcomes

Fit Indices	χ^2	df	p	χ^2/df	GFI	IFI	TLI	CFI	RMSEA
Observed values	2.64	2	0.001	1.30	0.982	0.992	0.991	0.983	0.03

According to Table 17, the obtained values for GFI, IFI, TLI, and CFI are all above 0.90, and the RMSEA value is 0.03. These results indicate an excellent fit for the structural model of outcomes.

The significance of outcomes was also examined. The table below presents the mean, standard deviation, and results of the one-sample t-test for assessing the significance of outcomes. Based on the obtained results, the mean of outcomes and its components is significantly higher than the theoretical mean at the 0.05 alpha level.

Table 18. One-Sample t-Test for Outcomes

Components	Mean	SD	t	df	Sig.
Outcomes (Total)	4.79	0.40	90.18	396	0.001
Achievement of Deep and Sustainable Learning	4.81	0.46	79.31	396	0.001
Strengthening Critical Thinking, Creativity, and Problem-Solving	4.77	0.47	74.95	396	0.001
High Motivation and Responsibility in Learning	4.79	0.43	82.51	396	0.001
Preparation for Real-World Challenges	4.79	0.44	81.43	396	0.001

The results presented in Table 18 indicate that, in the dimension of outcomes, all weighted mean values are statistically significant. Accordingly, principals and teachers considered the identified components necessary and important.

In the qualitative phase, the project-based curriculum model in blended learning and its components were extracted. In the quantitative phase, and through confirmatory factor analysis, the fit of the models for each component was confirmed. At this stage, the project-based curriculum model in blended learning, as well as its illustration and fit, were examined.

The structural fit of the main model was examined. Overall, based on the results of the qualitative analyses, nine dimensions were extracted: objectives, content, teaching methods, evaluation, technology, educational space, learning activities, challenges and drawbacks, and outcomes. Each of these dimensions included several components, all of which were individually examined and their fit was confirmed. At this stage, given the breadth of the dimensions and components, the values related to the components were aggregated and examined in the overall model as indicator variables.

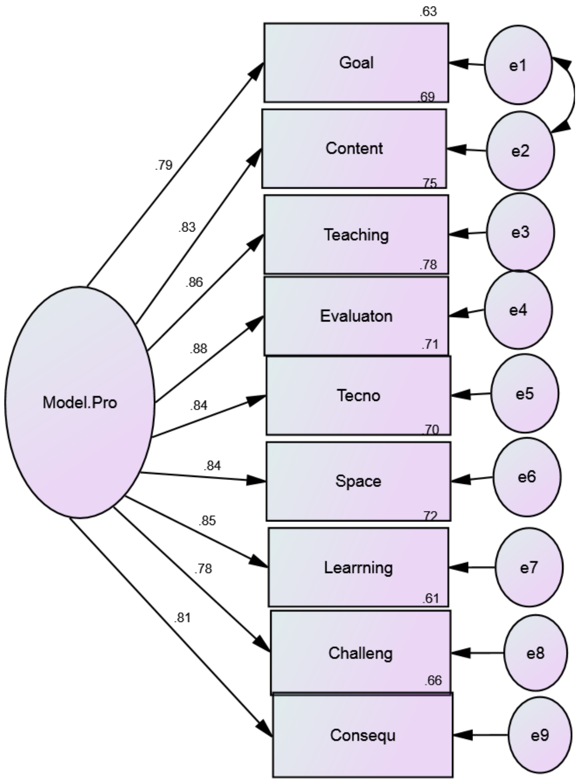


Figure 10. Fitted Model of the Main Pattern

Based on examination of the model with empirical data, the model related to the main project-based curriculum pattern in blended learning was confirmed. The path coefficients depicted in the above model are significant at the 0.05 alpha level. The main model fit indices are presented below.

Table 19. Fit Indices for the Main Model

Fit Indices	χ^2	df	p	χ^2/df	GFI	IFI	TLI	CFI	RMSEA
Observed values	68.75	24	0.001	2.86	0.961	0.985	0.978	0.985	0.07

According to Table 19, the obtained values for GFI, IFI, TLI, and CFI are all above 0.90, and the RMSEA value is 0.07. These results indicate an acceptable fit for the main project-based curriculum model in blended learning.

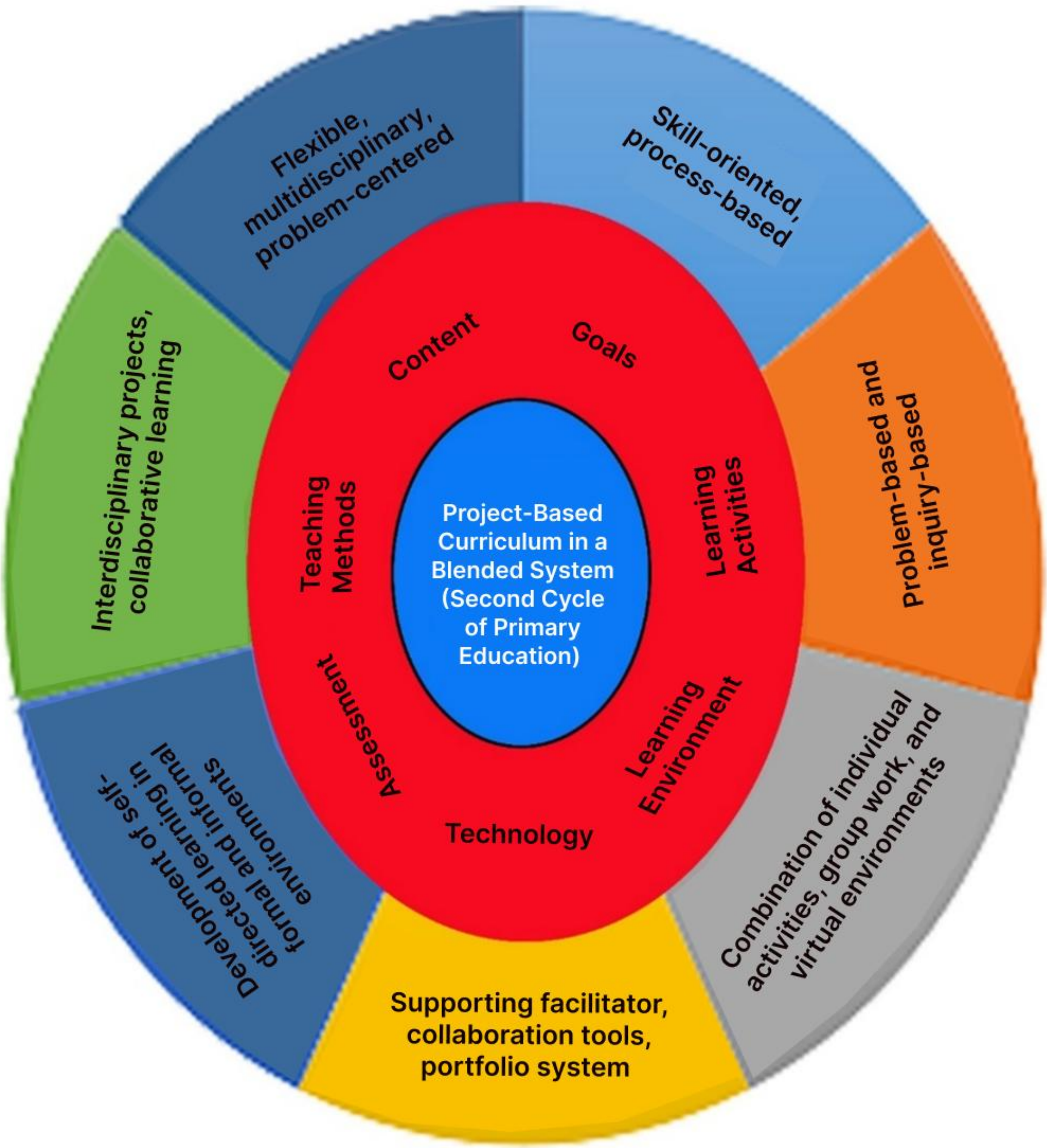


Figure 11. Proposed Project-Based Curriculum Model in the Blended System of the Second Cycle of Primary Education

Discussion and Conclusion

The findings of the present study led to the development and validation of a comprehensive project-based curriculum model within the blended learning system of the second cycle of primary education. The results demonstrated that the core paradigm of the model is grounded in project-based learning integrated within a blended environment, structured around key dimensions including objectives, content, teaching methods, evaluation, technology, learning activities, educational space, challenges, and outcomes. The confirmatory factor analysis results indicated that all dimensions of the model achieved acceptable to very good levels of fit, with significant path coefficients and appropriate values for fit indices such as CFI, GFI, and RMSEA. In addition, the results of the one-sample t-tests showed that all dimensions and their components had mean values significantly higher than the theoretical average, suggesting that educational stakeholders perceived these components as essential and meaningful. Among the dimensions, learning activities, educational space, and outcomes exhibited particularly strong indicators, reflecting the centrality of active engagement, flexible environments, and meaningful results in the proposed curriculum model.

The identification of project-based learning as the core category aligns strongly with contemporary educational theories that emphasize active, learner-centered, and inquiry-driven approaches. The prominence of structural flexibility, digital constructivism, and real-world contextual learning in the model reflects a shift away from rigid, content-centered curricula toward dynamic and integrative learning systems. These findings are consistent with the principles of modern educational psychology, which highlight that meaningful learning occurs when learners actively construct knowledge through interaction, experience, and reflection (1). Similarly, the emphasis on teacher facilitation and student-centered inquiry corresponds with established teaching skill frameworks that advocate for guiding rather than directing learning processes (2). The current findings extend this perspective by demonstrating that such pedagogical principles can be systematically embedded within a blended learning curriculum model, thereby enhancing both theoretical coherence and practical applicability.

The strong validation of the objectives and philosophy dimension, particularly its focus on real-world problem solving, creativity, critical thinking, and lifelong learning, is supported by previous research highlighting the effectiveness of project-based learning in fostering higher-order cognitive skills. Empirical studies have shown that project-based learning can significantly improve cognitive flexibility, interdisciplinary understanding, and academic achievement when aligned with authentic tasks and meaningful objectives (5). Moreover, the development of learning-to-learn competence and self-efficacy in project-based environments further reinforces the importance of such objectives in contemporary curricula (6). The present study contributes to this body of knowledge by demonstrating that these objectives are not only theoretically desirable but are also empirically validated within a structured curriculum model in blended learning environments.

The findings related to content design, which emphasized interdisciplinary, flexible, and learner-centered content, are also consistent with previous studies. Reducing reliance on rote memorization and increasing the depth and integration of content reflects a paradigm shift toward meaningful learning. Research has shown that interdisciplinary content enhances both cognitive and social development by allowing learners to connect knowledge across domains and apply it in practical contexts (10). Furthermore, aligning content with learners' interests and real-life situations has been identified as a critical factor in increasing motivation and engagement, particularly in blended and digital environments where learner autonomy plays a central role (13). The current study reinforces these findings by empirically validating content as a key dimension of the project-based curriculum model.

The results related to teaching methods, which emphasized student-centered, collaborative, inquiry-based, and problem-solving approaches, further support the effectiveness of project-based learning in blended environments. Previous studies have shown that teacher-student interaction and teacher creativity significantly influence students' academic performance and engagement in project-based settings (8). Additionally, guided inquiry and facilitative teaching roles have been identified as essential for fostering independent thinking and collaborative learning (11). The current findings confirm that such teaching methods are not only theoretically aligned with project-based learning but are also empirically supported within a structured curriculum framework.

The evaluation dimension of the model, which emphasized formative, process-oriented, and performance-based assessment, represents a significant departure from traditional assessment practices. This finding is supported by studies indicating that conventional testing methods are insufficient for capturing the complexity of learning in project-based and blended environments. Research has shown that alternative assessment approaches, such as portfolios, self-assessment, and peer evaluation, provide more comprehensive insights into students' learning processes and outcomes (18). The present study confirms the importance of such approaches and demonstrates their integration within a validated curriculum model.

The integration of technology as a core dimension of the model highlights the critical role of digital tools in supporting project-based learning in blended environments. Previous research has shown that digital platforms, artificial intelligence, and interactive technologies can enhance collaboration, access to resources, and personalization of learning (4, 16). However, the effectiveness of these technologies depends on their pedagogical integration rather than mere availability. The current findings align with this perspective, emphasizing that technology should be used to facilitate inquiry, collaboration, and real-world application rather than simply digitizing traditional instruction. At the same time, the identification of challenges such as infrastructural limitations, teacher resistance, and lack of resources is consistent with previous studies on virtual and blended education (12, 14, 15). These findings highlight the importance of addressing both technical and human factors in the implementation of blended learning curricula.

The strong validation of the learning activities dimension underscores the importance of active, collaborative, and inquiry-based tasks in achieving meaningful learning outcomes. Research has shown that project-based activities can enhance metacognitive awareness, creativity, and problem-solving skills, particularly when they involve real-world challenges and collaborative engagement (7). The current study extends these findings by demonstrating that such activities can be systematically integrated into a comprehensive curriculum model. Similarly, the findings related to educational space emphasize the need for flexible and technology-enhanced learning environments that support collaboration and practical engagement. This aligns with research indicating that learning environments play a crucial role in shaping student interaction, motivation, and performance (17).

The outcomes dimension of the model, which included deep and sustainable learning, enhanced critical thinking, increased motivation, and preparation for real-world challenges, reflects the ultimate goals of contemporary education. These findings are consistent with previous research demonstrating that project-based learning can lead to significant improvements in both cognitive and affective outcomes (5, 10). The confirmation of these outcomes within a blended learning context further highlights the potential of integrating project-based approaches with digital technologies to achieve comprehensive educational goals.

The validation of the main model, which integrated all identified dimensions into a coherent framework, represents a significant contribution to the field of curriculum design. The acceptable fit indices and significant relationships among dimensions indicate that the proposed model is both conceptually sound and empirically supported. This finding suggests that project-based learning in blended environments can be effectively operationalized through a structured curriculum model that aligns objectives, content, pedagogy, assessment, technology, and learning environments. The study thus provides a comprehensive framework for understanding and implementing project-based curricula in contemporary educational contexts.

One limitation of the present study is that the data were collected within a specific educational context, which may limit the generalizability of the findings to other regions or educational systems. Additionally, although the sample size in the quantitative phase was adequate, the reliance on self-reported data from teachers and administrators may introduce response bias. Another limitation is that the study focused primarily on curriculum design and validation, without examining long-term implementation outcomes or student-level performance data.

Future research is recommended to test the proposed model in different educational contexts and cultural settings to enhance its generalizability. Longitudinal studies could examine the long-term impact of implementing the model on student achievement, motivation, and skill development. In addition, future studies could explore the role of specific technologies, such as artificial intelligence and virtual reality, in enhancing project-based learning within blended environments.

In practice, it is recommended that educational policymakers and curriculum designers adopt a systemic approach to implementing project-based curricula in blended learning environments. Teacher training programs should focus on developing facilitation skills and digital competencies. Schools should invest in technological infrastructure and create flexible learning environments that support collaboration and inquiry. Assessment systems should be reformed to emphasize process-oriented and performance-based evaluation methods.

Acknowledgments

We would like to express our appreciation and gratitude to all those who helped us carrying out this study.

Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

References

1. Seif AA. Modern Educational Psychology: Psychology of Learning and Instruction. 6th ed. Tehran: Doran; 2023.
2. Shabani H. Teaching Skills. Tehran: SAMT; 2022.
3. Al Lily AE, Ismail AF, Abunasser FM, Alqahtani RHA. Distance Education as a Response to Pandemics: Coronavirus and Arab Culture. Technology in Society. 2020;63:101317.
4. Kartashova LA, Gurzhii AM, Zaichuk VO, Sorochan TM. Digital Twin Technology for Blended Learning in Educational Institutions During the COVID-19 Pandemic. CTE Workshop Proceedings. 2024;11:411-26.
5. Miller EA, Li T. Designing for and investigating elementary students' cognitive flexibility, science, and literacy achievement in project-based science learning. Disciplinary and Interdisciplinary Science Education Research. 2025;7. doi: 10.1186/s43031-025-00131-1.
6. Chan SC, Chan WT, Xiao JJ. Learning how to learn: the relationships between students' learning-to-learn (L2L) competence, learning self-efficacy, and achievement in project-based learning. Journal of Educational Business. 2025:1-10. doi: 10.1080/08832323.2024.2449506.
7. Shekh-Abed A. Metacognitive self-knowledge and cognitive skills in project-based learning of high school electronics students. European Journal of Engineering Education. 2024. doi: 10.1080/03043797.2024.2374479.

8. Khaleghi Yeleh Gombadi M, Ghayourpour S, Sheikhverdipour A, Ghazi Pour S, editors. The impact of project-based learning, teacher-student interaction, and teacher creativity on improving students' academic performance and sustainable learning2025.
9. Baptista VEG. Project-Based Learning Materials to Enhance Creative Thinking in Grade 7 Science. International Journal of Research and Innovation in Social Science. 2025;IX(IIIS):3763-83. doi: 10.47772/ijriss.2025.903sedu0271.
10. Firdausih F, Yusnelli Y. Literature Review: The Effectiveness of Project-Based Learning in Developing Social and Cognitive Skills of Secondary School Students. INJOSEDU: International Journal of Social and Education. 2025;2(2):281-92.
11. Ebrahimi A, Mirshah Jafari SE, Rabbani Khorasgani A. Identifying and Explaining the Requirements of a Project-Based Teaching-Learning Strategy in Accordance with the Generational Characteristics of Today's Students. Journal of Studies in Teaching and Learning. 2021;13(1).
12. Abbasi Dareh Bidi A, Ebrahimi A. Challenges and Opportunities of Virtual Education from the Perspective of Shiraz Teachers During the COVID-19 Period. Journal of New Advances in Psychology, Educational Sciences, and Education. 2021;4(42).
13. Ebrahimi M, Alishah F, Zamanipour F. Identifying and Analyzing the Opportunities and Challenges of Virtual Education from Students' Perspectives. New Educational Approaches. 2022;16(2).
14. Baghernejad R, Araqieh A. Interaction of Teaching and Learning in the Virtual Education System During the COVID-19 Period. 2022.
15. Kaspar K, Burtniak K, Ruth M. Online Learning During the COVID-19 Pandemic: How University Students' Perceptions, Engagement, and Performance Are Related to Their Personal Characteristics. 2023.
16. Dan Q. National Smart Learning Platform Supports Project-Based Learning and Activates After-School Activity. Leading Smart Education. 2025. doi: 10.1007/978-981-97-8148-5_42.
17. Barens R. Positive Teaching, Positive Learning. London: Routledge; 2019.
18. Esmaili Shad B. Analyzing Teachers' Lived Experiences During the COVID-19 Period and Presenting an Applied Model for Implementing Assessment Processes in Blended Education After COVID-19. Journal of Educational Psychology Skills. 2022;13(1):1-21.
19. Ahmadi H. Foundations and Reasons for the Integration of the Two Concepts of Curriculum and Extracurriculum. Proceedings of the Applied Scientific Conference; Kerman: Resaneh Takhassosi Publishing; 2021.