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The Effect of Hybrid Learning on Academic Achievement and 21st Century Skills in Teacher Education

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Abstract: *The current research aimed to assess the effectiveness of hybrid learning supported by Microsoft Teams on the academic achievement and perceptions of 21st-century self-efficacy skills among students enrolled in the Introduction to Education course at [Anonymized]. To enhance reliability, a mixed-method approach was employed, enabling opinions to be collected from both experimental and control groups. A total of 36 prospective teachers participated in the study during the 2021-2022 academic year over 12-week period. While content analysis was used to analyze qualitative data, the t-test was used to analyze quantitative data. As a result of the research, no significant differences were obtained regarding the perceptions of academic success and 21st-century self-efficacy skills between the two groups. Furthermore, a majority of students in the experimental group reported a moderate impact on academic achievement and expressed a moderate level of satisfaction with the hybrid learning model. However, the hybrid learning model was not the preferred choice among the participants as it did not fully address their educational needs. Conversely, the study confirmed the effectiveness of the traditional teaching method in promoting academic achievement in the control group. This also highlights the importance of addressing students' educational needs when implementing such models. Finally, the results will contribute to the body of knowledge in this field and offer potential directions for future research.*

Keywords: *Hybrid learning; 21st-Century Skills; Microsoft Teams; Online Education.*

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Introduction

Hybrid learning (HL) was employed in educational systems before the emergence of Covid-19. Discussions among university instructors about the integration of face-to-face classroom strategies with online methods can be traced back to 2002 (Platonova et al., 2022). The blending of traditional face-to-face and online learning is the most prevalent form of HL (Graham, 2013). Colleges and universities have adopted HL for various reasons (Bruggeman et al., 2021), and its usage is increasing (Platonova et al., 2022; Chen, 2022). During the COVID-19 pandemic, many countries turned to HL due to the necessity to close schools for health reasons (Dilling & Vogler, 2022). As a novel teaching and learning paradigm, HL has been *acknowledged since the dawn of the 21st century (Dilling & Vogler, 2022). Research indicates that HL led to a decline in student performance during the COVID-19 pandemic (Goldhaber et al., 2022). One of the most significant challenges identified in studies on HL is the communication between teachers and students (Sellnow-Richmond et al., 2019). Studies have shown that pedagogical innovations are necessary to enhance the motivation and learning of students participating in hybrid classes remotely (Sellnow-Richmond et al., 2019; Chen, 2022). In HL, remote students' interactions with their peers and instructors play a crucial role as they can significantly impact their learning experiences. Pedagogical approaches are required to facilitate the participation of remote students in physical classrooms. To enhance the educational experience, ensure a positive impact, and improve the learning processes of students taking courses online in HL, it is recommended that a model encompassing three key elements should be implemented, namely social presence, teaching presence, and cognitive presence (Garrison et al., 2000).

Currently, limited information is available regarding the benefits of HL (Sellnow-Richmond et al., 2019). Therefore, this study aims to investigate whether the gains obtained through the HL method by prospective teachers who will be practicing the teaching profession in the modern environment differ significantly from those achieved through traditional teaching methods. Furthermore, the perspectives of prospective teachers on HL and traditional teaching methods are compared. In the quantitative part of this study, the effectiveness of the traditional learning method with HL supported by Microsoft Teams is examined in terms of academic success and 21st century self-efficacy perceptions. Moreover, it is significantly important that hybrid learning

supported by Microsoft Teams is assessed, which has been employed in extraordinary circumstances such as COVID-19 or in the context of equal educational opportunities, on academic achievement and the perception of 21st-century self-efficacy skills.

It is anticipated that the results of the current study will contribute to the field by highlighting aspects that educators should consider and measures that should be implemented when employing HL. Additionally, the results of this study will aid prospective teachers in choosing teaching approaches and methods in their future careers. Furthermore, it is vital to obtain students' views both in the control and experimental groups who experienced both Microsoft Teams-supported HL and traditional learning classes. The contributions include insights into the ease or difficulties of learning experienced by prospective teachers in the experimental group during the experimental phase. Similarly, the opinions of students in the control group who were instructed using traditional learning methods are thoroughly detailed in the results section. From a broader perspective, the significance of this research lies in its contribution to transforming HL into a theoretical framework. Researchers in the field emphasize the need for HL, particularly in the new normal. In that regard, this study is critically important as it reveals the advantages and disadvantages of HL.

The importance of the teaching profession has been increasingly emphasized during the Covid-19 pandemic, demonstrating that teaching perseveres under all circumstances. While certain technological advancements in teaching had been made before the Covid-19 pandemic, the crisis accelerated the integration of technology into education. The transition from traditional to online education during the pandemic underscores the profound connection between teaching and technology. With the closure of schools due to the COVID-19 pandemic, face-to-face education was halted, and teachers transitioned to online teaching utilizing technology. Although Industry 4.5 and 5.0 societies had already benefited from technological tools for online education before the pandemic, the sudden and rapid shift from traditional to online education imposed by the pandemic was an emergent situation, and many countries had to swiftly incorporate technology into their teaching processes (Pal & Vanija, 2020; Colville et al., 2022). At this juncture, teachers had to actively employ their knowledge of computer usage and educational technology in their teaching processes. The pandemic demonstrated the critical need for teachers to possess 21st-century skills.

Concepts such as distance learning, blended learning, and online learning gained prominence in the education literature during the Covid-19 pandemic. Due to digital technologies, distance learning became increasingly prevalent during this period (Vidić et al., 2022). Distance learning is a form of education where the learner and the teacher are not physically present together (Tepe, 2021). The COVID-19 pandemic had a rapid and profound impact on universities (Johnson et al., 2020), and subsequently, they transitioned from traditional education to distance learning (Pal & Vanija, 2020; Mucuk et al., 2021). Universities offering teacher training programs were also forced to make a swift transition to online learning (Aguilera-Hermida, 2020). Since online learning brings its own technological challenges, universities providing teacher education initially instructed their teaching staff about online courses (Camilleri & Camilleri, 2021) and provided them with the required information on Learning Management Systems (Johnson et al., 2020). Teachers adopted digital and virtual teaching methods, and in the foreseeable future, even beyond COVID-19, the integration of educational technology into higher education must be accelerated. Additionally, universities should invest in online learning infrastructure and resources while enhancing conditions for both students and lecturers. In the study of Camilleri & Camilleri (2021), respondents indicated that access to an online resource center that offered information on how to rapidly transition to online learning was the most beneficial type of training. Such a resource center can provide teaching staff with immediate and easy access to essential information on online education, thus facilitating the transfer of information and skills related to online education to teacher candidates.

In the increasingly globalized world, societies must transform in order to thrive. However, preparing students for the future necessitates more than the subject-based and rote-learning skills of traditional education. Students must be equipped with 21st-century skills to address the challenges that will face them in the future. This means that students must not only be endowed with high-level thinking skills but also with the knowledge and skills necessary for navigating the ever-changing global landscape. Higher-order thinking encompasses cognitive processes involving critical thinking, problem-solving, and creative thinking skills (Kale, 2003). When engaging in critical thinking, individuals evaluate and seek answers to questions like 'what to believe' in order to make logical judgments. It involves setting criteria for actions and beliefs, thinking skeptically, and questioning explanations until all pertinent information is gathered. Problem-solving is the systematic and analytical determination of unknowns using known information. The

process encompasses explanation, generalization, prediction, and testing predictions. Creative thinking produces original solutions, information, and thinking processes (Kale, 2003). The 21st century necessitates individuals who possess these skills and behaviors allowing them to address the complex problems of the contemporary world. In this study, teachers' perceptions concerning their professional knowledge while performing their roles are defined as self-efficacy. The self-efficacy perceptions of teachers about their professional skills indicate the extent to which they utilize cognitive, affective, and psychomotor behaviors while performing their profession. These self-efficacy perceptions are considered essential skills and high-level competencies that enable teachers to adapt or respond to changes, keep abreast of technology, select information from rapidly growing volumes of data, analyze and evaluate that information, apply the acquired knowledge in their daily lives, and transform it into tangible products (Anagün et al., 2016). In a knowledge-based society, teachers must possess 21st-century skills.

Numerous organizations have identified the skills essential for individuals in the 21st century, including the Assessment and Teaching of 21st-Century Skills, Partnership for 21st-Century Learning (P21), Organization for Economic Co-operation and Development (OECD), Asia Society Partnership for Global Learning, and European Union. Equipped with these skills, students will be better prepared to address ongoing social, economic, and political challenges on a global scale, and can adapt to changing times. The integration of 21st skills into the undergraduate programs of university education departments will enable teacher candidates to adapt accordingly. Teachers who have acquired these skills can then employ them in their teaching processes and impart them to their students.

Based on the previously established theoretical foundations of using Microsoft Teams-supported hybrid learning (MTHL), this study investigates the effect of this approach on prospective teachers' academic achievements and their perceptions of 21st-century skills and self-efficacy. This study aimed to reveal the effectiveness of HL, employed during the COVID-19 pandemic, highlight the significant role of technology-supported education in increasing academic success, and help learners acquire the 21st-century skills they will need in the future. Therefore, the current study differs from others in the field as it focuses on the use of MTHL in teacher education. Additionally, it is expected that MTHL will contribute to the ability of prospective teachers to acquire 21st century skills.

Considering the inevitability of technology-supported teaching in the future societies of Industry 4.0 and 5.0, the present research is considered to

be significant in terms of emphasizing the elements that need to be taken into account in teacher training for HL. Alongside the importance of equal opportunities in education, remote learning and HL will also gain prominence during extraordinary circumstances such as wars, pandemics, and earthquakes. It is evident that both synchronous and asynchronous remote learning and HL will be utilized as instructional methods in the future. Additionally, it is crucial to address the pedagogical aspects teachers will need to consider when employing remote learning methods in the societies of the future. Understanding the variables that to require attention to enhance the learning levels of students who participate in classroom settings becomes paramount. Furthermore, adjustments in the aspects of the curriculum such as objectives, content, learning and teaching experiences, along with assessment situations are also crucial. The significance of this study lies in its contribution to identifying measures needed to motivate such students in a similar manner to traditional classroom settings and achieve instructional goals. Moreover, the study is also important as it contributes to the establishment of fundamental principles when incorporating technology-based methods like HL in teacher education programs.

In this study investigating the effect of online MTHL, the following questions were sought: (1) Is there any prominent difference in academic achievement in the Introduction to Education Course (EEG) between the control group to which MTHL was applied and the experimental group to which the traditional method was used? (2) Is there a significant difference in terms of 21st-century skills and self-efficacy perceptions between the control group and experimental group? (3) How do the experimental group students perceive MTHL compared to the control group students' views on traditional teaching methods?

Literature review

During the Covid-19 pandemic, many countries have increasingly adopted HL, commonly known as blended learning, which combines face-to-face and web-based learning for various levels of education (Garrison & Kanuka, 2004; Zhang, 2008; Korucuk, 2019). It represents a fusion of in-person and online learning experiences, delivered either synchronously or asynchronously (Kastornova & Gerova, 2021). In the context of HL, substantial learning content and interaction opportunities are provided online through software and teaching tools, while students also meet face-to-face in a classroom setting (Zhang, 2008; Kaur, 2013).

HL, as a pedagogical concept, entails the combination of online and classroom-based instruction to facilitate and support learning (Boelens et al.,

2015). In this context, instructors are required to switch from traditionally preferred face-to-face teaching to a different instruction style. In order to create the necessary blended learning environment, students leverage advanced web-based technologies like Learning Management Systems (Wang, 2021). One of its primary advantages is the flexibility it offers to students, who can access learning materials and recorded course videos anytime and from anywhere.

In the enriched HL environment, teachers and students can more easily access information, engage in social interaction to share their thoughts and feelings, and collaboratively develop solutions for the challenges they encounter (Koç, 2021). HL offers a multitude of features, including open dialogue, critical discussions, debates, and reconciliation, all of which align with the goals of higher education.

In a study conducted with higher education students, participants indicated a preference for the HL model as their second choice after the traditional face-to-face education model (Tepe, 2021). This potentially suggests that synchronous HL creates a more flexible and engaging learning environment compared to fully online or entirely on-site instruction (Raes et al., 2020). Zhang (2008) considered HL to be an optimal approach to education. Chen (2022) concluded that the design of online discussion platforms significantly impacts students' academic achievement, although the overall satisfaction levels of students remain unaffected. The results of Eren's (2019) showed that the HL environment positively affects students' success. In the study of Wang et al. (2018), the effect of the blended synchronous learning environment was examined. The study emphasized the crucial role of audio quality and effective communication between remote and face-to-face learners and teachers in preparing an effective blended synchronous class setting. In the study of Bağcı & Yalın (2018), it was concluded that students in the HL environment adapted according to the 5E model achieved higher, more permanent and sustainable academic results compared to students in the normal HL environment.

In the study of Abdelmalak & Parra (2018), graduate students' views on the design and implementation of a HyFlex course, which provides flexibility in choosing between an in-person or online learning environment, were explored. The study concluded that participants regarded HyFlex as an effective course model, facilitating access to course content and instruction while allowing the use of different learning styles and strategies. Lastly, in the study of Ceylan (2015), it was determined that the HL environment significantly influenced student achievements.

Generally, the positive impact of HL on student achievement and satisfaction levels has been well-established in the literature (Dziuban & Moskal, 2011; Dziuban et al., 2011; Means et al., 2013; Dziuban et al., 2018). However, it is important to note that some studies have also reported the negative effects of HL on achievement, communication, interaction, and socialization. For instance, in a comparative study conducted by Sellnow-Richmond et al. (2019) that investigated the effectiveness of teaching and learning outcomes in fully online and hybrid courses, students who enrolled in both fully online and hybrid modalities expressed disappointment regarding technology and drew attention to the lack of interaction with both their peers and the instructor.

Microsoft Teams is an open and accessible real-time collaboration and communication application that provides a platform for online meetings, file sharing, and app collaboration (Microsoft, 2018). Initial results and student feedback regarding the use of Microsoft Teams in education have been overwhelmingly positive (Martin & Tapp, 2019). Students have reported that Microsoft Teams is an effective platform that is easy to learn and use, offering more benefits compared to the platforms they previously used (Buchal & Songsore, 2019). Additionally, students have provided constructive feedback about Microsoft Teams and rated their collaborative skills as good or excellent in the projects in which they participated (Buchal & Songsore, 2019).

Methodology

Research design

In this study, a concurrent triangulation strategy was used. In this strategy, the researcher collects both quantitative and qualitative data simultaneously and then compares the two databases to determine whether there are convergences, differences, or any combinations (Creswell, 2009). Therefore, in this research, both quantitative and qualitative methods were employed to determine whether MTHL had a significant impact on academic achievement and 21st-century skills compared to traditional instruction, as well as to ascertain the opinions of students in the experimental and control groups regarding the applied teaching methods.

Below, first the procedures related to the quantitative dimension of the research are explained. Then, the procedures related to the qualitative dimension are given.

Quantitative Part

In the quantitative section, it was aimed to determine whether there were any prominent differences in students' achievements both in control and experimental groups based on the conducted methods. Further, it was attempted to evaluate their impact on 21st-century skills. A quasi-experimental design was used in the quantitative part of the research in which the experimental and control groups were selected without random assignment (Creswell, 2009). A non-equivalent control group design was used in the study. Of the four first-grade groups in ATTA, one was assigned as the experimental group and the other as the control group. In this study, the IEC Academic Achievement Test was administered as a pre-test and post-test to both groups to determine the impact of MTHL in the experimental group compared to traditional instruction in the control group. Additionally, the 21st-Century Skills Self-Efficacy Scale was administered as a pre-test and post-test to determine the impact of the applied methods on the 21st-century skills self-efficacy perceptions of students in both the experimental and control groups. The necessary permission to carry out the study was received by Atatürk Teacher Training Academy with the decision numbered G/79/22.

Sample of the study

The research was conducted during the Covid 19 period. There were 4 naturally formed first-grade groups in ATTA. Among the four groups, the group that would come to school and attend face-to-face lessons was assigned as the control group. Among the other three groups, one of the volunteer groups was assigned as the experimental group. Since groups were assigned from naturally formed groups based on volunteering, the convenience sample method was used (Creswell, 2009). A total of 36 prospective teachers participated in the research, where 26 of the candidates (72.2%) were female and 10 (27.8%) were male. All of the prospective teachers were first-year students taking the IEC for the first time. The experimental group consists of 20 and the control group consists of 16 prospective teachers. Given the study's objective to assess the impact of the independent variables on the dependent variables, pretests and posttests were administered to both groups. Written informed consent was obtained from the participants and they were informed that participation in the study was voluntary. They were advised that they could withdraw from the study at any time and that their data would be deleted accordingly.

Analysis of quantitative data

Quantitative data were utilized to analyze the academic achievement levels and 21st-century skills self-efficacy perceptions of prospective teachers regarding the IEC. Various quantitative analysis methods, including percentages, means, standard deviations, and independent sample t-tests, were employed. In the analysis of quantitative data, the Skewness Kurtosis test was used to evaluate whether the data were normally distributed. The t-test was used to determine whether there was a significant difference in the experimental and control groups. The interpretation of the quantitative data analysis results was conducted at the 0.05 significance level, which was considered statistically significant.

Qualitative part

The qualitative part of the study used a case study approach. Case studies are 'an inquiry strategy in which the researcher examines a program, event, activity, process, or one or more individuals in depth' (Creswell, 2009,13). Interviews were used as a qualitative research technique in the study. A structured interview form developed by the researcher was used to determine students' views in both groups based on the applied teaching methods.

Participants of the study

In the qualitative phase of the research, a total of 20 students were interviewed. Among these, 10 prospective teachers were purposefully selected from both the experimental and control groups, following Creswell's recommendations (2009, 178). The research procedure began with the execution of experimental procedures, followed by interviews with participant students selected from both the experimental and control groups. These interviews aimed to provide detailed explanations regarding the teaching methods that were implemented. In the quantitative phase of the research, a quasi-experimental design with a pretest-posttest control group was utilized.

Analysis of qualitative data

In the analysis of qualitative data, content analysis was utilized, which Berg & Lune (2015) defined as a meticulous, detailed, and systematic examination and interpretation of specific materials to identify themes, patterns, meanings, and biases. To enhance the research's reliability, various strategies were employed. In addition to seeking expert opinions on the interview questions, a member checking approach was applied.

Data Collection Tools

Atatürk Teacher Training Academy Entrance Exam

Currently, Atatürk Teacher Training Academy (ATTA) operates as a higher education institution in North Cyprus. Students can gain admission to ATTA based on their scores in either the ATTA Entrance Exam or international exams. The ATTA Entrance Exam covers questions from five subjects, all of which are part of the current high school curriculum, namely Mathematics, Turkish, Science, Social Sciences, and English. The exam follows a multiple-choice format, with a 1/4 point deduction for each incorrect answer (Atatürk Öğretmen Akademisi, 2022). Candidates seeking admission to ATTA based on internationally recognized exam scores must submit a minimum of three international exam scores for evaluation. Examples of such international exams include Cambridge IGCSE, Cambridge International AS/A Levels, and IELTS. The scores from the exams submitted by candidates before the interview are converted into a 125-point scale. Following the entrance exam and evaluation of international exam scores, candidates are interviewed by a five-person jury. The total score is calculated by combining the scores obtained from the written exam and the interview. The required admission score for ATTA is determined by adding the interview score to either the scores from the ATTA Entrance Exam or the scores from the international exams.

Introduction to Education Course Academic Achievement Test

The academic achievement test, developed by the researcher to assess the cognitive abilities of teacher candidates in relation to the IEC to evaluate instructional objectives, comprises 40 items and is scored on a scale of 100 points. The test has been carefully designed to align with the proficiency levels of the teacher candidates. It follows a multiple-choice format with five options provided for each question, with only one correct answer for each. During the development of the item options, particular emphasis was placed on minimizing the impact of guessing on the success of the candidates. The options for each item were crafted to enable a clear differentiation between those who possess the correct knowledge and those who do not. Additionally, a guide was created and included with the test to provide teacher candidates with explanatory details about the number of questions in the test, its duration, the point values assigned to each question, and the fact that each question has a single correct answer. To assess the internal consistency of the test, Cronbach's alpha was employed, resulting in a coefficient of 0.837. An alpha coefficient exceeding 0.70 indicates the reliability of the measurement tool (Büyüköztürk, 2011).

21st-Century Skills Self-Efficacy Scale

Based on the imperative for teacher candidates to acquire and apply 21st-century skills in the learning and teaching processes, researchers have introduced the YBEAT assessment tool to gauge these skills (Anagün et al., 2016). In this study, the original scale developed by Anagün et al. (2016) was utilized after securing the necessary permissions. The scale comprises 42 items and employs a five-point Likert scale, with response options ranging from (1) Never to (5) Always. It enables participating teachers to articulate their perceptions of self-efficacy in utilizing 21st-century skills, indicating how frequently they employ these skills and their confidence levels in doing so. YBEAT encompasses three distinct factors: Learning and Innovation Skills, Life and Career Skills, and Information, Media, and Technology Skills. Together, these factors account for 51.30% of the total variance. The items exhibit factor loading values ranging from .35 to .80. Additionally, the study revealed significant correlations between the sub-dimensions of the scale, with values spanning from .28 to .50 at a significance level of .01. For the scale's internal consistency, the Cronbach's alpha coefficient was computed at .889. Furthermore, the alpha coefficients for individual factors were determined to be 0.845 for Factor 1, 0.826 for Factor 2, and 0.810 for Factor 3. It is noteworthy that this scale has been designed to cater to all teacher candidates pursuing education in various fields.

Semi-structured interview form

To address the research questions, the researcher developed a set of semi-structured interviews featuring open-ended questions. Initially, eight interview questions were crafted based on the literature review findings. Subsequently, expert opinions were sought to refine the interview questions and align them with the study's objectives. Resultantly, six open-ended questions, supplemented by probing questions, were ultimately formulated for inclusion in the interview protocol. The qualitative data collected from these interviews underwent rigorous content analysis. This process involved the identification of themes and categories, which were then organized, tabulated, and subjected to frequency calculations. To maintain the confidentiality and privacy of participants, data were anonymized by assigning abbreviations, such as ETC1 and ETC2, to students in the experimental group, while CTC1 and CTC2 were used for those in the control group. Each participant engaged in face-to-face interviews lasting approximately 40 minutes, conducted in a quiet environment to ensure candid conversation. Prior to the interviews, participants provided informed consent, and the sessions were recorded. To enhance the reliability, various strategies were employed. In addition to

seeking expert opinions on the interview questions, a member checking approach was applied. This involved validation meetings with participants, either individually or collectively, to further bolster the study's validity, as recommended by Creswell (2009, 191). During these meetings, participants were asked to confirm whether the findings gleaned from the semi-structured interviews accurately reflected their own perspectives. At these meetings, all participants affirmed that the findings aligned with their personal viewpoints.

Implementation

In the experimental group, teacher candidates learned through MTHL, while the control group received face-to-face education following the traditional teacher training program. Courses were designed to run for 1 day and 2 hours per week for both the experimental and control groups, with the researcher overseeing the implementation.

For the experimental group, courses were delivered in a blended manner, with three subgroups taking turns attending face-to-face or online classes every week. One subgroup participated in face-to-face classes, while the other two groups followed the lessons remotely via the Microsoft Teams app. The following week, the rotation continued.

This arrangement allowed the researcher to interact with the experimental group either online or in person, meeting one subgroup in the classroom for 1 day and 2 hours every three weeks and delivering synchronous courses for 1 day and 2 hours per week to the other two subgroups. The control group, on the other hand, received traditional instruction, which involved lectures using the question-answer method and an end-term project. The project required each teacher candidate to select an article related to the IEC topics, examine it, and then present it to the class.

At the start of the term, the researcher created a virtual classroom on the Microsoft Teams app for all students across the three different groups participating in hybrid education. The virtual classroom, named 22 EBG (SNF109), served as a repository for course materials, including course descriptions, PowerPoint presentations for all subjects, project guidelines, and midterm exam records.

Results

The results obtained from the data, aligning with the study's objectives, are as follows:

The Skewness-Kurtosis normality distribution test was employed to assess whether students' ATTA Entrance Exam (AGIS) scores and 21st-Century Skills Self-efficacy Perception Scale (YBEAT) total scores, as well as subtest scores used as pretests, were normally distributed. As presented in Table 1, the normality values for the AGIS scores of both the experimental and control groups were 0.75 and 1.52, respectively, according to the Skewness-Kurtosis normality test results. Furthermore, the Skewness-Kurtosis normality test results for the YBEAT subtests and total scores were as follows: -0.285 and -0.48, -0.365 and -0.675, -1.805 and 1.165, 0.279 and -0.976. These values were obtained by dividing the Skewness-Kurtosis coefficients by the standard error of skewness and kurtosis, and they all fell within the range of -1.96 to +1.96, indicating that the data exhibited a normal distribution (Can, 2014).

Table 1. Skewness-Kurtosis normality test for AGİS and YBEAT of the experimental and control groups.

	N	Skewness Statistic	Std. Error	Kurtosis Statistic	Std. Error
AGIS	36	0.294	0.393	-1.167	0.768
21st-C. Learning and Innovation Skills	36	-0.112	0.393	-0.369	0.768
21st-C. Information, Media and Technology Skills	36	-0.143	0.393	-0.518	0.768
21st-C Life and Career Skills	36	-0.356	0.393	-1.005	0.768
21st-C. Skills Self-efficacy Perception Scale Total Score	36	0.110	0.393	-0.750	0.768

Prior to the implementation, AGİS was employed to assess the similarity levels of the groups.

Additionally, YBEAT was utilized as a pretest to evaluate the groups' similarity levels (refer to Table 2). Following the completion of the intervention, post-tests were administered to both the experimental and control groups. The data derived from AGIS, used to determine academic similarity levels, and the pre-test consisting of YBEAT administered to both groups, were subjected to analysis using the independent samples t-test technique. The obtained values were interpreted at the 0.05 significance level.

Table 2. AGIS and 21st-Century Skills Self-Efficacy Perception pretest scores.

Group	N	Mean	SD	df	T	P
Academic achievement level						
Experimental	20	87.81	9.3965	34	0.351	0.352
Control	16	89.01	11.1362			
21st-C. Learning and innovation skills						
Experimental	20	61.75	6.463	34	0.173	0.864
Control	16	62.13	6.449			
21st-C. Life and Career Skills						
Experimental	20	76.35	5.613	34	0.641	0.526
Control	16	77.44	4.258			
21st-C. Information, Media and Technology Skills						
Experimental	20	34.10	3.959	34	0.498	0.622
Control	16	34.75	3.804			
21st-C. Skills self-efficacy perception total score						
Experimental	20	172.20	13.679	34	0.537	0.595
Control	16	174.31	8.654			

As shown in Table 2, there is no significant difference between the AGIS scores of the experimental group (Mean=87.81, SD=9.396), and the control group (Mean=89.01, SD=11.136) (t=.351, p>0.05). There is also no significant difference between the YBEAT levels of the experimental group (M=172.20, SD=13.679), and the control group (M=174.31,SD=8.654) (t=0.537, p>0.05). Additionally, t=0.173, p>0.05 for Learning and Innovation Skills, t=0.641, p>0.05 for Life and career skills, and t=0.498, p>0.05 for Information, media and technology skills, and there is also no significant difference concerning the YBEAT subtests. The findings demonstrate that the academic levels and 21st-century skills self-efficacy perceptions of the experimental and control groups have a homogeneous structure.

Academic Achievement Levels of Experimental and Control Groups Concerning the Introduction to Education Course

The normality of the data was assessed using the Skewness-Kurtosis normality test, and the results are presented in Table 3. According to the test results, the post-test scores of the experimental and control groups were -1.72 and 0.18, respectively. This statistical analysis confirms that the post-test scores for both groups exhibit a normal distribution, ensuring the validity of the data for subsequent analyses.

Table 3. Skewness-Kurtosis normality test for AGIS scores of the Experimental and Controlgroups.

N	Skewness Statistic	Std. Error	Kurtosis Statistic	Std. Error
36	-.676	.393	.143	.768

As observed in Table 4, the difference between the means of the academic achievement post- test scores for students in both the experimental and control groups within the IEC is not statistically significant ($t = -0.521$, $p > 0.05$). Consequently, it cannot be asserted that the hybrid education method supported by Microsoft Teams is more effective than the traditional method in significantly improving students' performance in the IEC. Nonetheless, it can be concluded that its effectiveness in enhancing educational outcomes is similar to traditional education.

Table 4. Group t results of the post-test scores.

Group	N	X	SD	Df	T	P
Experimental	20	25.90	6.456	34	-,521	.606
Control	16	24.75	6.728			

21.st-century skills self-efficacy perception levels of the students in the experimental and control groups

The Skewness-Kurtosis normality test was employed to assess normality. According to the results of the Skewness-Kurtosis normality test, the subtests and YBEAT total scores of students in both the experimental and control groups exhibit skewness-kurtosis coefficients of -0.80 and -0.23; -1.80 and 1.16; 0.11 and -0.04, respectively. The values obtained when dividingthe Skewness-Kurtosis coefficients by the standard error of skewness and kurtosis fall within the range of -1.96 to +1.96, indicating that the data follow a normal distribution (Can, 2014).

Table 5. Skewness-Kurtosis normality test for 21st-Century Skills Self-Efficacy Scale for Experimental and Control Groups.

	N	Skewness Statistic	Std. Error	Kurtosis Statistic	Std. Error
21st-C. Skills Learning and Innovation Skillssubtest	36	0.565	0.393	0.074	0.768
21st-C. Life and Career Skills	36	-0.315	0.393	-0.180	0.768
21st-C. Information, Media and Technology Skills	36	-0,709	0.393	0.895	0.768
21st-C. Skills and Self-efficacy Total Score	36	0.043	0.393	-0.031	0.768

As indicated in Table 6, there is no significant difference between the YBEAT scores of the experimental group (M=173.75, SD=14.15) and the control group (M=171.56, SD=12.70) (t=- 0.482, p>0.05). Furthermore, there is no significant difference in the subsets of YBEAT, including Learning and innovation skills (t=-0.278, p>0.05), Life and career skills (t=-0.319, p>0.05), and Information, media, and technology skills (t=-0.653, p>0.05). Based on these findings, it cannot be concluded that hybrid education supported by Microsoft Teams is significantly more effective than the traditional method in enhancing the self-efficacy perception levels of prospective teachers regarding 21st-century skills. However, it is reasonable to assert that it is equally effective as traditional education.

Table 6. Group t results of the post-test scores.

Group	N	Mean	SD	*df*	t	*P*
21st-C. Skills Learning and innovation subtest						
Experimental	20	63.30	6.216	34	-0.278	0.783
Control	16	62.75	5.495			
21st-C. Skills Life and Career Skills						
Experimental	20	76.45	6.270	34	-0.319	0.752
Control	16	75.75	6.865			
21st-C. Information, media, and technology skills						
Experimental	20	34.00	3.464	34	-0.653	0.538
Control	16	33.06	5.131			
21st-C. Skills self-efficacy Total Score						
Experimental	20	173.75	14.149	34	-0.482	0.633
Control	16	171.56	12.702			

The experimental group students' opinions regarding MTHL and the control group students' opinions regarding traditional teaching methods

The comparative opinions of the students are presented in Tables 7, 8, and 9 below. Table 7 displays the analysis of the responses given by the experimental and control group students to questions such as "How effective do you think the teaching method in the class is on your academic performance?

Table 7. The views of the prospective teachers regarding the effects of implemented methods on their academic achievement

Experimental Group			Control Croup		
1. Was the method effective in your success?			1. Was the method effective in your success?		
Themes	Codes	f	Themes	Codes	F
Moderate	Distraction at home	4	A lot	I was able to take notes, I had to listen	5
	Focusing problem	3		There is live communication with the teacher	4
	I watched the recordings	1		I understood better	1
	It lowered my grade	1			
A little	Inability to concentrate	1			
2. Did you like the method used in the course?			2. Did you like the method used in the course?		
Themes	Codes	f	Themes	Codes	F
Moderate	I would like it face-to-face	5	A lot	Better concentration on the teacher	5
	It allows communication with the instructor	1		The lesson was productive	2
	HL must be developed	1		I became more motivated for the course	2
	I didn't like it much	1		The course was enjoyable	1
	I am not satisfied	1			
A little	It does not contribute to the student's learning	1			
3. Did the method used in the course meet your educational needs?			3. Did the method used in the course meet your educational needs?		
Themes	Codes	f	Themes	Codes	F
Yes	Yes, it addressed	1	Yes	Includes question-answer method	3
				Enables interaction between teacher and students	2
				I loved going to school	1

				I understand when someone	1
				tells something	1
				Appeals to different sense organs	
No	It lowered my motivation	4	No	The course did not address me	1
	No communication	2			
	with the instructor	1			
	I couldn't take notes	1			
	It is not student oriented.				
4. Should the method used in the course be used in future courses?			4. Should the method used in the course be used in future courses?		
Themes	Codes	f	Themes	Codes	F
No	It would be better if it is not used in other courses.	6	Yes	It needs to be used	8
				It ensures permanent learning	1
	It should not be used	2			1
	It should not be used unless necessary	2		It must be used	

As shown in Table 7, almost all students in the experimental group considered the impact of MTHL on their academic achievement to be at a "moderate-level", while all the students in the control group considered the impact of the traditional in-person learning on their academicachievements to be "a lot".

The following views of the students on this issue are noteworthy: '*I didn't feel like I was really present in the classroom, which caused my attention to wander. Therefore, this moderately affected my performance*'. (ETC10).

'*Seeing facial expressions and knowing that the other party (individual) is there is a much more relaxing teaching method for me. Whether it's an expression or a question-and-answer method, F2F is more effective for me*'. (CTC7).

As observed in Table 7 above, almost all students in the experimental group indicated that they liked MTHL at a 'moderate' level, while all students in the control group stated that they liked thetraditional learning method 'very much.'

The following students' views in the control and experimental groups are noteworthy on this subject:

'I moderately liked the hybrid learning method. Dear teacher, if we had always been present face-to-face during the class, I think my grades could have been better.'. (ETC7)

'*For me, the traditional teaching method was even more effective because I could take notes. For instance, from what you said, from your facial gestures, I could*

understand what was important, and I would put an asterisk on those points, or underline them.' (CTC2).

As shown in Table 7 above, almost all of the students in the experimental group stated that MTHL did not meet their educational needs, while almost all of the students in the control group stated that the traditional learning method met their educational needs.

The following students' views are noteworthy on this subject:

'*The method did not meet my educational needs because I was not very motivated. I can say that I could not pay much attention to the sessions. If it was face-to-face, I would have to be much more attentive.*' (ETC2).

'*I think the method took my educational needs into great consideration. I enjoyed going to school; waking up in the morning, preparing for that class, going there, and learning face-to-face in that classroom environment, I really loved it*'. (CTC4).

As shown in Table 7 above, all students in the experimental group did not want MTHL to beused in other courses, while all students in the control group wanted the traditional teaching method to be used in other courses as well. On the other hand, almost all students in the control group considered that the traditional teaching method should be used in other courses available in the upper grades of undergraduate education.

The following students' views are noteworthy on this matter:

'*As previously mentioned, it should not be used due to problems such as power cuts, inadequate technological infrastructure, interrupted internet access, inability to come to the classroom and be active, distractions, and not being able to socialize.'*. (ETC3).

'*Face-to-face teaching is more effective and it should be used as it facilitates communication and interaction.*'. (CTC3).

Table 8. Students' views regarding the advantages, disadvantages, and elements that need to be amended and the use of the method.

Experimental Group			**Control Group**		
Themes	Codes	f*	Themes	Codes	f*
1. The advantages of the method	Video recordings	7	1. The advantages of the method	Course follow-up	10
	Not wasting time going to school	6		Active participation in the lesson	9
	Not waking up early	4		Teacher effectiveness	9
	Teacher effectiveness	2		Communication with the teacher (eye contact, dialogue)	8
	Flexibility	1		Asking questions	7
	Relaxed environment (No tension)	1		Focusing (attention)	4
				Socialization	2
				Concentration	2
				Motivation	2
				Increase in academic success	1
				A better understanding of the subject	1
2. The disadvantages of the method	The problem of active participation in the course	10	2. The disadvantages of the method	Waking up and going to school	4
	Audio	7		Sometimes, there is direct instruction	1
	Internet interruption	7			
	Power cut	6			
	Inability to ask questions	6			
	Lack of motivation	5			
	Inability to concentrate	5			
	Teacher effectiveness	5			
	Screen display	5			
	Technological incompetence	4			
	Distractibility	4			
	Socialization	3			
	Interaction with the teacher	2			
	Noise (at the beginning and end of the lesson)	2			
3. Elements of the method that need to be	Sound system	9	3. Elements of the method that need to be	Nothing needs to be corrected	3
	Technological infrastructure	7		More active participation	3
	Camera	7			1
		4			

corrected	Hybrid learning	4	corrected	More events	1
	training for	4		Exam method (Project	1
	instructors	2		evaluation)	1
	Internet	1		More discussion	1
	Teaching methods	1		Student chairs	
	Image	1		More questions	
	Event rooms in	1		More apps	
	Teams				
	More attention to				
	remote participants				
	Hybrid learning for				
	students				
	Lesson durations				
	(must be short)				
4. Would you	I don't use it	5	4. Would you	I would definitely use	7
use this	I don't use it unless I	4	use this	it.	3
method	have to	1	method	I would use it.	
when you	I would use it as long		when you		
become a	as it's not too much.		become a		
teacher?			teacher?		

Experimental Group			**Control Group**		
Themes	Codes	f*	Themes	Codes	f*
1. The advantages of the method	Video recordings	6	1. The advantages of the method	Course follow-up	10
	Not wasting time going to school	6		Active participation in the lesson	9
	Not waking up early	4		Teacher effectiveness	9
	Teacher effectiveness	2		Communication with the teacher (eye contact, dialogue)	8
	Flexibility	1		Asking questions	7
	Relaxed environment (No tension)	1		Focusing (attention)	4
				Socialization	2
				Concentration	2
				Motivation	2
				Increase in academic success	1
				A better understanding of the subject	1
2. The	The problem of active participation in	10	2. The	Waking up and going to school	4

**Each student provided more than one opinion.*

As seen in Table 8, the majority of the students in the experimental group (f=7) considered the video recordings of the courses as an advantage of MTHL, while not wasting time by going to school was considered another advantage of MTHL by just over half of them (f=6). All of the students in the control group indicated that the advantages of the traditional teaching method were as follows: following the course (f=10), active participation in the course (f=9), the teacher's effectiveness (f=9), communication with the teacher (f=8), and asking questions (f=7).

The following students' views are noteworthy:

'Despite everything, hybrid learning had certain conveniences because we recorded the courses, and we could listen to or watch those recordings later.'. (ETC3).

'Following the lesson is definitely an advantage. I mean, the internet may be interrupted during online education at home, and something may happen. I may feel sleepy. Everything can happen. Participation in the lesson physically is better.'. (CTC4).

As shown in Table 8, all of the students in the experimental group indicated the following disadvantages of MTHL: Problems in active participation in the course (f=10), audio problems (f=7), internet interruption during the course (f=7), power cuts during the course (f=6), not being able to ask questions and lack of motivation. Slightly less than half of the students (f=4) in the control group considered the need to wake up early and go to school a disadvantage of the traditional teaching method.

The following views of the students on this matter are noteworthy:

'Active participation in the lesson is a disadvantage as well since nobody is very attentive and listens. Well, when the instructor asked a question, everyone was unaware of the question as they were not listening. Therefore, there was a lack of interaction'. (ETC6).

'When we consider it in terms of time, going to school and coming back home is a disadvantage because we waste time.' (CTC5).

According to Table 8, almost all of the experimental group students (f=9) considered the sound system as an element of MTHL that needs to be corrected. The majority of the experimental group students (f=7) considered that the technological infrastructure and the camera system should be improved.

While some students (f=3) in the control group stated that no elements of the traditional teaching method needed to be corrected, some of them (f=3) believed that more active participation and more activities should be ensured to improve the traditional teaching method.

The following views of the students on this matter are noteworthy:

'Because we could neither hear you nor could you hear us clearly. Webcams could have been put in the classroom, it would have been more comfortable, and we could have followed you all the time.'. (ETC3).

'I think there was nothing about the method to be corrected. For me, everything was OK'. (CTC4).

As seen in Table 8, half of the experimental group students stated that they would not use MTHL when they became teachers, while less than half stated that they would not use it unless it was compulsory. On the other hand, almost all of the control group students (f=7) mentioned that they would definitely use the traditional teaching method when they became teachers, while less than half of them (f=3) stated that they would use it.

The following students' views are noteworthy on this matter:

'*I don't prefer to implement a course in primary school with the hybrid learning method because I think face-to-face teaching is a better method as it enables me as a teacher to conduct thecourse better.'*. (ETC1).

'*When I become a teacher, I will prefer to use face-to-face (F2F) education because it allows me to explain the subject much more comfortably.*'. (CTC7).

Table 9. Students' views regarding their attitudes towards the lesson.

Experimental Group			Control Group		
Themes 1. What is the effect of the method on your attitude towards the lesson?	Codes	f	Themes 1. What is the effect of the method on the attitude towards the lesson?	Codes	F
High	Course topics	1	High	The method was very effective in my liking of the course.	5
				There was interaction with the teacher and friends	4
				I was able to comment	1
Moderate	The topics of the lesson and the way the teacher explained them were effective.	3 1	Moderate		
	The method was effective in making me like the course	1			
	was effective that I liked the lesson.				
	The method has had a great impact.				
Low	My attitude towards the course is related to my liking of the teacher.	1 1	Low		
	I couldn't attend the lesson.	1			
	The teacher's level of importance attached to the course	1			
	It was entirely due to the method.				

As seen in Table 9, half of the students in the experimental group (f = 5) stated that the method had a moderate effect in determining their attitudes towards the course. Control group students stated that the method had a high impact on determining their attitudes towards the course.

The following views of the students on this matter are noteworthy:

'I cannot say that I liked the course because of the method. I liked the lesson because of your way of explaining, the examples you gave, and the topics that caught my attention.'. (ETC3).

'The method had a great effect on determining my attitude towards the course. because if you like a course, you are motivated for that course.'. (CTC4).

According to the quantitative data, no significant differences were found in the academic achievement and self-efficacy perceptions of 21st-century skills between the experimental group using MTHL and the control group using traditional teaching methods. However, the qualitative data did not support the quantitative findings. According to the qualitative data, students in the control group using traditional teaching methods generally found the teaching method effective, while students in the experimental group did not find MTHL effective.

Almost all of the students in the experimental group found that MTHL had a moderate effect on their academic achievement, moderately liked the method, stated that it did not meet their educational needs, and did not want it to be used as a teaching method in their future courses. However, all of the students in the control group found the traditional teaching method to be very effective on achievement, the majority stated that the method met their educational needs, and expressed a desire for it to be used as a teaching method in their future courses.

Almost all of the students in the experimental group mentioned that one of the advantages of MTHL was the ability to record class videos. They perceived the disadvantages of the method to be audio issues, internet disconnection during class, power outages during class, difficulty in asking questions to the teacher and classmates, and experiencing motivation problems. Almost all of them also mentioned the need for improvement in the technological infrastructure and camera system, stating that they would not use MTHL when they become teachers.

All of the students in the control group mentioned following the class, active participation in class, effective teaching by the teacher, communication with the teacher, and asking questions as advantages of traditional teaching methods. Almost all of the control group students stated that they would definitely use traditional teaching methods when they become teachers.

Discussion

According to the overall results of this study, it cannot be said that MTHL is more effective than the traditional method on the academic achievements and self-efficacy perceptions of 21st century skills of prospective teachers. However, it can be concluded that MTHL is as equally effective as traditional face-to-face education. This finding is in line with those of Olapiriyakul & Scher (2006), Delialioğlu (2009), Szeto (2014), Fitriyana et al. (2021) and Korucu & Kabak (2020).

The findings based on the qualitative data did not support the quantitative data findings of the study. According to the qualitative data, the students in the control group, to whom the traditional teaching method was applied, found the teaching method effective in general, while the experimental group students did not find the MTHL effective. Since the qualitative data findings do not support the quantitative data findings, there are aspects that should be taken into account if MTHL will be used in education by prospective teachers when they become teachers in the future.

The reasons why the MTHL approach implemented in this study did not create a significant difference in the academic achievements and 21st century self-efficacy perceptions of teacher candidates may be related to some limitations of the study. Bower et al. (2015) stated that teachers should implement pedagogical strategies and workarounds to maximize learning, classroom or community building, and student experience in HL designs. Eren (2019) suggested that designing platforms taking into account the individual needs of students will increase the efficiency of education. Korucu & Kabak (2020) emphasized that to ensure the effectiveness of HL, the needs and demands of all stakeholders should be reflected in the plans before implementation. Al-Sholi et al. (2021) stated that higher education institutions should provide support to faculty members and students in HL implementation. Baran & Sadık (2021) also emphasized that in hybrid education systems, faculty members should improve their knowledge of distance education, instructional design and pedagogy. In general, the authors emphasized the necessity to make arrangements in HL pedagogy to ensure successful results.

An explanation as to why there are significant difference in this study may be that students' individual needs could not be incorporated into the HL design. The inability to determine and include the individual needs of the students in the program due to the conditions imposed by the Covid-19 pandemic is one of the limitations of this experimental study. Another reason why there is no significant difference may be related to technology. As (Anonymized) is a developing country, due to the exhaustion of fuel

during the Covid-19 pandemic and the government's inability to manage the relevant process quickly, electricity was cut off in different cities on an alternating basis. Internet access was also interrupted intermittently due to power cuts. For this reason, the students in the experimental group, who were receiving the course remotely, experienced problems with internet access and attending synchronous online courses. This may have negatively affected their academic achievements. In the study of Korucu & Kabak (2020), it was determined that prolonging the implementation period of HL eliminated the statistically significant effects on success. This experimental study covered a long period of 12 weeks, which could be considered as another factor causing no significant difference to be detected between the groups in terms of academic success.

As HL is a technology-based education, the quality of the technological infrastructure is the most important variable influencing the effectiveness of hybrid learning. Researchers have emphasized the necessity to provide the necessary infrastructure and possibilities for HL implementation (Marey et al., 2022; Kazu & Yalçın, 2022). Bower et al. (2015) emphasized that technology reliability and performance pose a problem in HL and that technology has been found to have critical impact in many studies (Chakraborty & Victor, 2004; Pope, 2010; Stewart et al., 2011; Wang, 2021).

Bower et al. (2015) emphasized the importance of preparing the learning environment for simultaneous learning activities for synchronous HL. Rasheed et al. (2020) stated that students and teachers encounter challenges when using technology in HL environments, including technological competence and qualifications, preparing quality online videos for students, negative beliefs, and technological operation difficulties. Yurdakal & Susar Kırmızı (2021) also emphasized that teacher candidates experienced problems regarding system and internet speed when distance education was urgently implemented. Marey et al. (2022) stated that ensuring that the voices of lecturers and students are classroom are adequately transmitted to the students participating remotely is a significant issue. Park et al. (2019) emphasized that continued participation in online activities can help underperforming students improve, which may have contributed to the successful completion of the HL course. Triana (2021) stated that some problems regarding how to ensure participation in online learning have been encountered. Universities have found it challenging that the existing classrooms in schools and universities have not been designed with the HL model in mind (Korucu & Kabak, 2020; Marey et al., 2022). This challenge also includes sound-related issues such as sound equipment, room size, and acoustics. Audio problems in terms of being able to hear the voices of

students who were participating remotely in discussions that were held to ensure their active participation were experienced since the sound was only transmitted from the lecturer's speakers. When students who attended the classroom physically for in-person learning and students who attended the synchronous learning activity remotely stated that they could not hear the sounds well, the lecturer resorted to methods such as repeating the topic or questions or asking the students to be silent. This problem may have caused a loss of motivation and interest, especially in students attending remotely, and restricted their active participation in the discussions. Therefore, this may account for the absence of a significant difference in academic achievement between the experimental and control groups.

Some studies have found that HL has positive effects on cognitive success (Özdemir, 2008; Arispe & Blake, 2012; Shams, 2013; Chen & Chiou, 2014; Abdelmalak & Parra, 2018; Park et al. 2019; Kazu & Yalçın, 2020; Korucu & Kabak, 2020), while other studies have reported a positive effect on affective behaviors (Korucu & Kabak, 2020), Hapke et al., 2021; Jumabaeva et al., 2021).

Due to the successful effect of HL revealed in the studies mentioned above as well as the health, political and social issues experienced in the current era, it is inevitable that hybrid education will be used more widely. HL will become one of the indispensable methods in education systems in the future as it has many outstanding advantages over traditional face-to-face education. Some authors have stated that future of education belongs to HL (Saini et al., 2020).

The use of HL combined with traditional face-to-face learning in education can be highly advantageous. Thanks to educational technologies, this model provides accessibility and flexibility allowing students to improve their individual learning capacity, learn at their own pace, and repeat for learning. Camilleri & Camilleri (2021) also predicted that the use of HL together with traditional face-to-face learning in higher education can be accelerated in the foreseeable future with the use of distance communication through the integration of educational technologies into higher education. Since HL is one of the educational methodologies benefiting from this type of education technology, the possibility of it being effectively used together with in-person learning in higher education will increase. Szeto (2014), Korucu & Kabak (2020) and Raes et al. (2021) emphasized the need for more research on HL.

The findings of this study point to innovations in the implementation of HL, especially in developing countries. The opinions expressed by the pre-service teachers who belong to the experimental group

regarding MTHLM are noteworthy in this context. The pre-service teachers stated that MTHLM has significant technological and psychological disadvantages. From a technological perspective, students who attend lessons remotely have problems hearing the voices of the instructor and other students in the classroom, they cannot ask questions to their peers in the class, and the quality of the screen image can be problematic. Additionally, electricity and internet outages were also stated important problems. From a psychological perspective, they stated that they have problems such as lack of motivation to participate in the lesson and problems with maintaining concentration. These are important factors to consider in the implementation of technological teaching methods such as HL in developing countries. Developing countries should solve their electrical problems before integrating technology-based learning methods such as HL into their education systems. Additionally, technological equipment should be designed before university buildings are constructed and the buildings and classrooms should be built with the technological infrastructure stated by Camilleri & Camilleri (2021), as this can be highly influential on the success of HL.

The fact that important arrangements need to be made in the pedagogical context can be considered as a new and valuable finding of this study. As stated by the teacher candidates, in order to maintain student motivation and participation, faculty members need to make arrangements that are different from the traditional pedagogical understanding, as stated in other studies (Sellnow-Richmond et al., 2019; Baran & Sadık, 2021; Chen, 2022). Additionally, the fact that the individual needs of the students could not be determined, such as when there was a very sudden and rapid transition to HL due to the pandemic, can be considered as an important limitation. In this case, considering how student needs will be taken into account and constantly monitoring the necessary measures are necessary for student success.

Limitations

The sample in this study was limited to AÖA students, which may have impacted the generalizability of the results. However, it is possible to compare these results by conducting further studies in different regions and countries. Also, a semi-structured interview form was used in the study, thus limiting the responses of the participants to the interview form in question.

Conclusion

As can be understood, scientific studies on HL have yet to reach a sufficient level of maturity. In particular, further experimental studies investigating all aspects of HL and its effects on learners are essential. It is thought that this study, which was conducted with the aim of investigating the effects of HL on prospective teachers' academic achievements and their 21st-century skills and self-efficacy perceptions, will contribute to the formation of the theory of HL in the empirical context. More experimental studies conducted to identify the challenges in HL and provide appropriate solutions will help ensure increased positive effects on student achievement, attitudes, and affective behavior. Considering the results of this study, it is recommended that attention be given to identifying students' individual needs and including them in the instructional programs of HL, developing technological equipment and infrastructure, avoiding lengthy implementation periods, setting up the audio equipment of the physical classroom in line with the communication requirements of HL, and taking the necessary pedagogical measures to ensure the active participation of students, particularly of those attending remotely. Provided that specific focus is attached to the recommendations mentioned above, it is likely that effectiveness of HL in achieving academic success will increase. Taking into account the qualitative findings of this research, it is crucial that efforts are made to redesign the HL method by addressing its disadvantages.

Ethical approval

This study was ethically approved by the "Atatürk Teacher Training Academy". (Ethics approval number G/79/22).

Informed consent

All individuals participating in the study provided a written informed consent form.

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