

Exploring the Effectiveness of Blended Learning Techniques for Science Students at Secondary Level

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Abstract

This research was carried out on the teachers' and students' perceptions of using Blended Learning techniques. Firstly, a questionnaire was designed and then distributed to 100 male and female teachers, of which 100 responses were received. Moreover, semi-structured interviews with the ten teachers were conducted to explore their deep views of the role and importance of Blended Learning. The findings showed that the teachers appreciate the value of Blended Learning in developing them professionally using Blended Learning techniques. The teachers reflected their positive views about independent learning using computers and the internet through assignment methods, classroom discussions, and projects that make their learners critical thinkers and autonomous. Teachers said they can use computers and online activities to develop assignments and prepare lessons and examination papers. Also, they are becoming fast in providing feedback to their students. The study concluded that male and female teachers who do not use Blended Learning techniques or are not computer-trained are comparatively less autonomous than the others. The recommendations are redesigning courses to identify strengths and weaknesses and directing future learning regarding blended techniques.

Keywords: Blended Learning, Audio-Video Aids, Multi-Media, Technology-Trained Teachers

1 Introduction

Blended Learning (which is blended with online and offline elements) is the context, having the organizing agent (the teacher) as a key attribute of the Tail technique, together with a computer (Sinha et al., [2022](#)). By blending: "physical synchronous and social forms—like teacher-led classes

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and lectures -with self-paced and asynchronous formats" (Shand & Farrelly, [2018](#)), Blended Learning means the integrated use of multiple pedagogical techniques and multiple instructional delivery formats in a combination of online and face-to-face training (Hrastinski, [2019](#); Halverson et al., [2017](#)).

The finest elements of online and face-to-face learning should be combined smartly to construct blended learning, which will likely be the core teaching methodology in the future. Vo et al. ([2017](#)) specified that the mixed-methods study was meant to determine if Blended Learning enhanced student success in middle schools within a public charter school system (Fazal et al., [2020](#); Kinta et al., [2019](#)). Blended learning is often defined as a combination of traditional teaching methods, such as face-to-face and online instruction (Wong et al., [2014](#)); (Yen & Lee, [2011](#)).

Although there is less evidence that teachers use Blended Learning techniques in schools than at the university level, a significant amount of literature on Blended Learning techniques demonstrates its critical importance for educational development for students and teachers' academic and professional growth (Güzer & Caner, [2014](#); Kumar et al., [2021](#)). In poor nations like Pakistan, teachers are less willing to change their lesson plans and incorporate new teaching strategies as required. Most educators use traditional teaching methods (Ashraf et al., [2021](#); Means et al., [2013](#)).

However, using Blended Learning strategies in the classroom was not improved following COVID-19 (Karma et al., [2021](#); Megahed & Hassan, [2022](#); Orji et al., [2021](#)). Following COVID-19, the focus shifted from traditional to online education, and instructors began implementing Blended Learning strategies in the classroom. However, despite its advantages, instructors have difficulty using Blended Learning strategies (Jeffrey et al., [2014](#); Rasheed et al., [2020](#)). This study concentrates on instructors who help science students comprehend science better by utilizing Blended Learning strategies. This study seeks to fill a knowledge gap in the literature while learning more about the technology used for Blended Learning.

1.1 Objectives of the Study

This study explores how teachers can improve their online teaching through Blended Learning. There are the following objectives:

1. To explore the teachers' understanding of Blended Learning.
2. To explore the students' understanding of Blended Learning.
3. To explore the benefits of using Blended Learning techniques
4. To explore the limitations of Blended Learning at higher secondary levels

1.2 Research Questions

The following research questions guide this study:

1. What are the teachers' understanding of Blended Learning?
2. What are the students' understanding of Blended Learning?
3. What are the benefits of using Blended Learning techniques?
4. What are the limitations of Blended Learning at the higher secondary level?

2 Literature Review

The effectiveness of Blended Learning has been the subject of several meta-analyses in the past decade and is part of the main subject explored in this research (Müller & Mildenerberger, [2021](#)). Improvements in this modality are oriented to educational and technical elements designed for this purpose (Galvis, [2018](#)). While over 95% of higher education in Canada involves some form of Blended Learning, research and practice have been broadening in the last two decades (Alammary et al., [2019](#)). However, with all the evidence-based research and applications, Blended Learning has been largely overlooked in Canadian educational institutions (Matheos & Cleveland-Innes,

[2018](#)). The development of Blended Learning has given rise to a new educational movement (Rojabi, [2019](#); Pitchford et al., [2018](#)). Over the past two decades, the development of online learning has served an increasingly diverse student body and the use of online teaching materials (Evans, [2020](#); Serrano et al., [2019](#)). Online learning is already a daily function of the educational environment, and how teachers are supported in developing online teaching strategies is critical to students' learning experience. Based on the delivery of a Blended Learning professional development course on how to become an online teacher at a Hong Kong institution (Bruggeman et al., [2021a](#); Evans et al., [2020](#)).

Mixed learning can take place at four different levels: the activity level, the course level, the program level, or the institutional level, according to Graham, who provides a typology of blended models (Fazalet al., [2020](#); Kinta et al., [2019](#); Nugraheni et al., [2020](#)). He notes that "the nature of the mixes is established by the designer or teacher, which is dominant at the course and activity levels as opposed to those of the institution and program, where academic administrators may influence the decision-making process" (Graham et al., [2019](#)). When a blend includes learning, an activity made up of face-to-face and computer-mediated components, it is said to be blended at the activity level (Maity et al., [2020](#)). Several degree programs allow students to take certain classes on campus and the rest online (Moskal et al., [2013](#); Rasheed et al., [2020](#)).

Every country has had a much more significant rise in online teaching and learning activities after the COVID-19 outbreak (Hockly, [2018](#)). Teaching and learning are now performed remotely and on digital platforms as a result of the devastating epidemic, which has significantly altered the character of the conventional educational system (Kumar et al., [2021](#); Moskal et al., [2013](#)). The question of whether online teaching and learning methods are just as successful as those used in traditional classroom settings now emerges. Many researchers think traditional classroom instruction is more successful than Internet instruction (Zajdel et al., [2021](#)).

The COVID-19 pandemic's online learning paradigm made it impossible to separate learning from using information technology (Jena, [2020](#); Ngoma et al., [2021](#)). This most recent way of living has changed how learning media are used in education. Technology and information products offer alternative learning materials in digital forms, such as interactive digital modules or electronic modules based on electronic multimedia. Saptiyah et al. ([2023](#)) assert that various print media, including a module, may be converted into digital or electronic forms, also called e-modules (Cullen, [2021](#)).

With today's technological breakthroughs, we may create online content in various ways. For online courses to be efficient and productive, it is crucial to consider learners' preferences and impressions (Huang & Hew, [2018](#)). The learner's choice is connected to their desire to engage in collaborative learning and the variables affecting their preparedness for online learning. This article summarizes the findings from the analysis of related literature (Muthuprasad et al., [2021](#)).

Before the Covid-19 epidemic, students learned in person in class (Navratilova et al., [2023](#)). To improve learning effectiveness, instructors take various approaches, including using learning tactics customized to their students' personalities and utilizing multiple learning materials, materials PowerPoint presentations, modules, and others (Hubackova et al., [2016](#); Okaz, [2015](#)). Despite Indonesia's extensive use of technology, teachers still rely on traditional teaching methods, including textbooks and PowerPoint presentations. Researchers used this method of learning even before COVID-19 happened (Wibawa & Payadnya, [2021](#)).

This article provides experience, research, design, and inclusive views on text versus video feedback in online contexts to fulfill students' emotional needs throughout the epidemic (Istenič, [2021](#); Kaplan-Rakowski, [2021](#)). Before the pandemic, online or virtual labs offered accessible and inexpensive science and technology education. Online laboratories for science, technology,

engineering, and math (STEM) have been acknowledged to enable cost-effective and safe exposure to these topics without being constrained by socioeconomic or geographic factors (Raman et al., [2021](#)).

M-learning, used to increase teaching and learning among students at the tertiary level, has continued to be of interest (Saikat et al., [2021](#); Suartama et al., [2019](#)). Extracurricular activities can be utilized to investigate the potential of video documentation outside of the classroom context (Gross & Pawlak, [2020](#)).

2.1 Gaps from the literature review

Previous studies in Pakistan are limited to this concept of Blended Learning in improving teaching skills. Only 4-5 techniques were found related to this concept.

1. Previous research mostly used qualitative methods for data collection. However, less emphasis is given to quantitative research designs.
2. In developing countries, including Pakistan, Blended Learning is a reasonably recent phenomenon in teacher education.
3. Using audio-video aids and blended learning techniques is a well-known phenomenon in Pakistan. Nonetheless, the old concepts of technical rationality and teacher-as-technician remain popular.
4. Programs relative to awareness of using Blended Learning techniques in the classroom are highly organized and heavily centered around apprenticeships.
5. When students and teachers begin formal teaching in schools, they frequently find Blended Learning techniques outside of scope and unconnected to the needs of actual teaching. As a result, these programs often fall short of preparing teachers capable of using Blended Learning techniques.

3 Research Methodology

A questionnaire and an interview offer two complimentary insights into the students' views. Each approach makes a distinctive contribution to exploring the issue in this research (Barbour & Barbour, [2003](#); Curry et al., [2009](#); Wickert et al., [2021](#)). There would be some similarities and dissimilarities between what participants reported in questionnaires and what they would articulate in interview data. Moreover, the benefit of collecting data from multiple sources allowed the researcher to carefully check and validate whether the researcher's interpretation of data is correct. Glaser and Strauss ([1967](#)) make the obvious point that data replication is the best means for validating facts. Strictly speaking, the use of questionnaires and interviews does not replicate data. It offers two insights, each of which can clarify, interpret, confirm, and validate the other. Overall, a mixed method design in this study provided sensible advantages in exploring the research questions (Morse, [2016](#)).

All the participants were asked to give their feedback. They were asked to put a question mark against any irrelevant statement item. The questionnaire was developed to explore teachers' beliefs and practices regarding using Blended Learning techniques to enhance students' learning. For this purpose, the pilot study was an important element of my research work. The questionnaire variables for the participants vary in gender, qualification, and age. The collected data proved helpful in getting feedback. The participants showed a positive response, and the results were encouraging. Participants' responses and feedback regarding the questionnaire gave valuable information. All the participants were satisfied with the content of the questionnaire.

The questionnaires were distributed personally to the Kahnur Education House and Millat High School Renala Khurd. The procedure for administering the data was implemented to ensure a reasonable return rate and valid data. The ethical codes of educational research were also abided by.

3.1 Interview Process

A significant factor in how teachers and students view the Use of Blended Learning techniques to enhance students learning. It has been noticed that the frequency of published qualitative research studies is, however, comparatively lower than quantitative research in Pakistan (Seidman, 2019). Accordingly, using qualitative approaches like interviews, focus groups, and observations is less common (Lune & Berg, 2017). Therefore, this study contributes to research on assessment, mainly using Blended Learning techniques in developing students' learning; I used qualitative approaches such as semi-structured interviews. The interviews were conducted in this study with ten teachers teaching at the secondary level and 4 Focus groups.

3.2 Reliability and Validity

The tool was pilot-tested, and a reliability analysis was done. The alpha coefficient was calculated. It was 0.87.

Validity was sort ensured through expert opinion.

3.3 Sample and Location

The researcher personally completed the data collection in Kahnur Education House and Millat High School Renala Khurd. The participants were asked to complete the consent form to show their willingness. Finally, the data collection process was completed in one week. The table below shows the details of the sampling.

Table 1: Sampling Detail

Name of District	No. of schools visited		Locality of school		Category of students		No. of students		Total
	Public	Private	Urban	Rural	Male	Female	Male	Female	
Okara	1	1	1	1	39	61	39	61	100

One hundred questionnaires were administered in public and private secondary schools in the urban and rural areas of the districts mentioned above. One hundred questionnaires were received, and the response rate was 100%.

3.4 Sampling and Participant Inclusion Criteria

The research study was conducted in Kahour Education House, Renala Khurd. The researcher selected convenient sampling involving cases that meet some important criteria. (Suri, 2011). The following criteria were used to decide the inclusion of participants in this study:

1. All the participants have experience with Blended Learning techniques.
2. All the participants had enriched information related to Blended Learning through the Zoom application.
3. All the participants have asses to the internet.
4. All the participants were willing to share their perceptions and experiences voluntarily.
5. All the participants approved of recording their interviews for transcription.

3.5 Qualitative Data Research

In the current study, semi-structured interviews were conducted to collect data. Usually, in a hermeneutic phenomenology research study, semi-structured interviews are the most frequently adopted option to collect data. During the dialogue, the researcher adds questions in a pre-planned interview form to pre-information from the participant. As per the study structure, more data is expected to be collected from fewer participants; the semi-structured interview is considered the most appropriate option. Semi-structured interviews were selected for their capacity to formulate questions well, listen attentively, analyze, investigate, or stimulate the interviewee successfully, and enable them to voice their thoughts. They facilitate interviewers' replies. This method

significantly aided in collecting detailed and enhanced participant data. Occasionally, the interviewer will have more critical aspects to elicit from the subject, and they can add additional questions to expound on that specific information.

3.6 Quantitative Data Research

The questionnaire is considered an important tool for educational research and is used on a large scale. The questionnaire consists of questions related to the prescribed research for data collection. It is constructed by keeping the specified rules in view. It is constructed for measurement. In this study, the questionnaires were first used to gather secondary school teachers' views about the role and importance of blended learning in enhancing students' learning. Questionnaires constitute an essential and famous technique widely used to study attitudes, opinions, perceptions, and preferences in educational research (Muijs, 2006; Reid, 2006). Oppenheim (2000) described the questionnaire: "The questionnaire is an important instrument of research, a tool for data collection." The total number of questions in the prescribed questionnaire about using Blended Learning techniques for developing autonomous teachers was 50. The researcher used items from closed-ended surveys since they are more frequently employed in quantitative studies and are objective items. To provide a suitable scale from 1 to 5, the researcher supplied response options (5-Likert scale).

3.7 Ethical Considerations

Before performing the study, a location was chosen that had no interest in the study's outcome. The university's consent was required. It was asked for permission to utilise unpublished tools or procedures that other researchers could claim as their own. Starting the study, its public release was its primary goal. No participant was ever required to sign a permission form. Indigenous community charters and laws are adhered to. It was critical to respect the study setting and keep disruptions to a minimum while conducting the research. According to data analysis, participants were not tricked. Reporting information acknowledging and recognizing any potential power disparities and participant exploitation by gathering data and then exiting the website without getting back to the participants, participants were not "abused." Publishing research data and materials preserved securely (e.g., raw data and protocol data).

4 Data Analysis

The researcher distributed 100 questionnaires to the participants. 100 out of 100 were returned. Therefore, the methodology used for distributing the questionnaires proved to be good in providing a high return rate. The table mentioned above describes briefly the total number of questionnaires distributed and the total number of students to whom the questionnaires were distributed. Also, the age limits of students were notified. The table shows 100 students, 61 males and 39 females, and all participants are between 20 to 25. This means that no student was above 25. Hence, the collected data show that most males are more cooperative in the research field than females, and all participants were above 20.

Section 1

Table 2: Role of Blended Learning

Sr	Items	SA	A	N	D	SD
1	Blended Learning meets students' learning needs.	67	30	3	0	0
2	Blended Learning promotes self-regulated learning.	44	46	9	0	1
3	Blended Learning improves communication between students and teachers.	63	22	15	0	0
4	Blended Learning develops students' interest in learning.	53	34	9	4	0
5	Blended Learning enhances students' use of technology.	54	25	10	8	3

The second part of the questionnaire contained five questions. In this part, the participants were asked to give their opinions on the role of Blended Learning in students' learning. A 5-Likert scale was used to measure this part, and the respondents were asked to place one tick on each line to show their views. This part was related to the questions (1) Blended Learning meets students' learning needs. So, according to this statement, 67 students strongly agreed, 30 agreed, and three were neutral. (2) Blended Learning promotes self-regulated learning, so, by this statement, 44 students strongly agreed, 46 students agreed, nine neutral, and one disagreed. (3) Blended Learning improves communication between students and teachers.

So, by this statement, 63 students strongly agreed, 22 agreed, and 15 were Neutral. (4) Blended Learning develops students' interest in learning. So, by this statement, 53 students strongly agreed, 34 agreed, nine were neutral, and four disagreed. (5) Blended Learning enhances students' use of technology. So, according to this statement, 54 25 students agreed, 10 agreed but were neutral, eight agreed but disagreed, and three strongly disagreed. Hence, the table shows that most of the participants strongly agree with the positive role of Blended Learning. They think that Blended Learning uses a whole technique to teach science students.

Table 3: Benefits of Using Blended Learning

Sr	Items	SA	A	N	D	SD
1	Blended Learning provides better access to educational resources like E-journal.	44	47	7	2	0
2	Blended Learning promotes self-directed learning.	37	50	10	3	0
3	Blended Learning makes students energetic in learning.	58	27	13	1	1
4	Students gained a good understanding of the concept by use of audio-video aids.	53	33	9	5	0
5	Students can study at their own pace with Blended Learning	62	24	9	3	2

The third part of the questionnaire was related to the benefits of using Blended Learning techniques. The participants were asked to tick the FIVE most important benefits that would assist them in teaching or learning. This part consisted of five statements. This part was related to the questions. (1) Blended Learning provides better access to educational resources. So, according to this statement, 44 students strongly agreed, 47 agreed, seven were neutral, and two disagreed. (2) Blended Learning promotes self-directed learning. So, by this statement, 37 students strongly agreed, 50 agreed, 10 were neutral, and three disagreed. (3) Blended Learning makes students energetic in learning. So, by this statement, 58 students strongly agreed, 27 students agreed, 13 students neutral, one student disagreed, and one strongly disagreed. (4) Students gained a good understanding of the concept.

So, 53 students strongly agreed, 33 students agreed, nine students were neutral, and five students disagreed. (5) Students can study at their own pace with Blended Learning. So, by this statement, 62 students strongly agreed, 24 agreed, nine were neutral, three disagreed, and two strongly disagreed.

Hence, the collected data show that most participants benefit from using Blended Learning Techniques. A few participants disagree with these benefits.

Table 4: Difficulties in Using Blended Learning Techniques

Sr	Items	SA	A	N	D	SD
1	Blended Learning infrastructure is not sufficient in schools.	45	41	9	4	1
2	The quality of the multimedia infrastructure is not suitable for lecture presentations.	40	37	15	4	4
3	Students cannot easily afford technology for the use of Blended Learning techniques.	53	24	14	5	4
4	In online classes, it is not easy to engage many students.	58	21	9	5	7
5	Blended Learning is useless for students in the backward area due to poor internet facilities.	57	19	9	4	11

The fourth part of the questionnaire was about the difficulties of using Blended Learning techniques. This section also contained five items. A 5-Likert scale response system was used to measure these items, and the respondents were asked to place one tick on each line to show their views. This part was related to the questions. (1) Blended Learning infrastructure is not available easily. So, by this statement, 45 students strongly agreed, 41 agreed, nine neutral, four disagreed, and one strongly disagreed. Hence, the collected data show that participants face difficulties using Blended Learning Techniques. Many of the participants disagree or strongly disagree with the given statements.

4.1 Thematic data analysis from Qualitative data

Theme one: Experiences Regarding Blended Learning

Participants were asked about their Blended Learning teaching experience. They were asked and probed to discuss their perspective on teaching approaches, which they favor, i.e., physical or online. They were asked about the multimedia that their schools provided them. Moreover, they asked about the application they used for online teaching.

Subtheme One: Teacher's Perspective Regarding Blended Learning

Collected data showed that most participants have one year of Blended Learning teaching experience. They used Blended Learning techniques for the first time during COVID-19. For example, a participant stated:

In Blended Learning Audio-Video Aids, we used tools to make teaching and explaining to students easier. (T 7)

On the other hand, few participants had three years of Blended Learning teaching experience.

In online learning for students, it is better to share a video instead of audio because the students will easily understand it to see visual lectures. (T 3)

One of the participants had four years of Blended Learning teaching experience.

Audio-video aids are the best way of teaching Blended Learning. (T 5)

Another participant stated that:

For Blended Learning, if the students are not active in the classroom. We can use audio-video aids to develop an interest in the study. (T 4)

Another participant from the Focus group stated:

The learning we do from YouTube and various tools called audio-video aids gives us many benefits. (FG1:2)

Hence, the Findings showed that Blended Learning assumes that hands-on experience with observing and manipulating scientific materials is better than other approaches for cultivating comprehension and enjoyment. Blended Learning builds the abilities needed for more complex study or learning.

Subtheme Two: The Best Method of Teaching

The collected data showed that most participants think the Blended Learning mode of teaching is the best way of teaching. Most teachers suggested using Blended Learning techniques in the classroom. The use of audio-video aids was beneficial for both teachers and students. For example, one of the participants stated:

In class, we used blended learning techniques to understand students better. (T 2)

Another participant stated that:

Making charts, forming models, and displaying videos on the projector in class are easy for teachers to explain and students to understand. (T9)

Another participant stated that:

In online learning, for students' understanding, it is better to share a video instead of audio because the students will easily understand it through a visual lecture. (FG3:3)

Hence, the Findings showed that Blended Learning may help students learn to address the challenges inherent in directly observing and manipulating the material world. Student collaboration among teachers increased, proving it is the best teaching method.

Subtheme Three: Importance of Audio-Video Aids

Most participants stated that using audio-video aids in the classroom is very helpful in explaining the topic. It will improve students' understanding of the given topic. During Covid-19, most institutes offered online classes. So, students habitually use audio-video aids. For example, one of the participants stated:

In online learning, sharing a video instead of audio is better because the students will easily understand it through a visual lecture. (T 6)

One of the participants stated:

Audio- Video is used because the effect in the video can never be achieved in audio. (T 2)

One of the participants stated:

The use of Audio-Video-Aids is the best way of teaching in Blended Learning. (T8)

Another participant from the Focus group stated:

Audio video aids called programs with which we read and clear our topics, for example, YouTube and Zoom app, etc. (FG4:11)

Another participant from the Focus group stated:

Audio-Video-Aids are the tools through which we are taught online and clear our concepts easily. (FG3:1)

Hence, the findings showed that blended learning helps enhance students' learning through audiovisual aids. Audiovisual aids play a vital role in learning, so if we have to learn science education, it is very important to use Blended Learning techniques in secondary schools.

Subtheme Four: Platform Used for Blended Learning

The collected data showed that all the participants used Zoom applications and Google Classroom, and most used projectors in the classroom for blended learning. They think that these applications are best to facilitate teaching. For example, one participant stated:

I used Google Meet, Zoom application, and Microsoft Teams. These applications are beneficial, but I mostly used the Zoom application because it has a video-recording option and can easily record your lectures. (T10)

One of the participants stated:

In Blended Learning techniques, using audio-video aids is the best way to teach. Making charts and forming model display videos on a projector in class is easy for the teacher and students to understand. (T9)

Hence, the Findings showed that Zoom applications, Microsoft Teams, and Google Meet were mainly used during COVID-19. In physical classes, projectors were used for lecture delivery. Using these applications gives positive feedback that students show interest in this teaching method.

4.2 Theme 2: Benefits of Using Blended Learning Techniques

Participants were asked about their Blended Learning teaching experience and probed to discuss their perspective on the benefits of Blended Learning, which method of Blended Learning was beneficial for students during COVID-19, and the multimedia benefits their schools provided them. Moreover, they were asked about the application they used the most for Blended Learning.

Subtheme One: Impact on Students

The collected data showed that most participants think student-teacher interaction is maximum when blended learning techniques are used. Teachers can easily engage in learning. Blended Learning can best conduct student assessment. For example, one of the participants stated:

After COVID-19, the Use of Blended Learning techniques greatly impacted students. When we were teaching online classes, it did not stop their studies, so when they returned to school, most of the syllabus was covered. (T4)

Another participant from the Focus group stated:

The advantages of Blended Learning are that we understand the topic easily and increase our interest in studying. (FG2:14)

Another participant from the Focus group stated:

The advantage of audio-video aids is that they do not waste time, and we can easily understand the lecture. If any topic is not clear, then we can understand our topic by using different tools. (FG3:12)

Hence, the Findings showed that using Blended Learning techniques for secondary students benefited students and teachers. In online classes during the pandemic, students were touched by their studies and enjoyed this Blended Learning method of teaching or learning.

Subtheme Two: Advantages of audio-video aids

The collected data showed that most participants used audio-video aids in the classroom. Using audio-video aids allows students to understand the topic more quickly than through traditional lectures. It will increase the student's understanding. For example, one of the participants stated:

The advantage of audio-video aids is that the students observe and understand them well. For example, we use projectors in class so students understand the topic easily. (T5)

Another participant stated that

There are many benefits of using audio-video aids, such as some science topics that are cleared by using videos on the projector, etc. They will be unclear if we explain the topics without an audio video. (T4)

One participant stated the advantages of audio-video aids in online classes:

Audio Video Aid has benefited the students in that their mindset has been set toward Video Aid. If a child does not understand a topic in class, he can go home and listen to online lectures to clear his concepts. (T8)

One participant from the Focus group stated:

The advantage of audio-video aids is that they do not waste time, and we can easily understand the lecture. If any topic is not clear, then we can understand our topic by using different tools. (FG1:19)

One participant from the Focus group stated:

The advantage of audio-video aids is that if we do not understand something, we can go home and watch the videos repeatedly to understand our topic. (FG4:1)

Hence, the findings showed that students have many advantages from using audio-video aids. They can repeat the lecture repeatedly if they fail to understand it for the first time. The video gives a visual view of the topic that is easily understandable by the students.

4.3 Theme Three: Students' Motivation in Blended Learning Classrooms

Teachers were asked about students' motivation in blended learning, interactions with blended techniques, and how to interest students by adding animations to slides or videos.

Subtheme One: Role of Animations

The collected data showed that most participants use animations to explain topics clearly in their lectures. It developed interest in students, which was helpful for teachers to cover topics quickly and clearly. For example, one participant stated:

Students get motivated by blended learning once they learn that the lectures are displayed on the projectors and the teacher uses different animations to explain topics to the students for a better understanding. (T7)

Another participant stated:

Students are motivated by audio-video aids in such a way that they are more understood if we add different animations to the slides or the videos. (FG2:7)

Hence, the findings showed that it is natural for children to be attracted to animations. So, the use of animations in slides is very beneficial for students as well as teachers. Students were interested in animated video lectures and slides (Busdayu et al., [2021](#)). Therefore, Animations play a vital role in students' understanding.

Subtheme Two: Result of Student's Motivations

The collected data showed that most participants agreed to use Blended Learning techniques for student motivation. Because it gave positive results on students' performance in examinations. For example, one of the participants stated:

Students get motivated so that if only audio is sent to them, they will not understand the topic properly; if we send the video, they will not feel bored and will understand the topic easily and get 80% marks in examinations. (T2)

One participant from the Focus group stated:

The advantages of blended learning are that it inspires us and creates interest in learning; if we do not understand something, we can easily understand it with the help of audio-video aids. (FG3:2)

Hence, the Findings showed that Students get too many motivations regarding their studies. They were most motivated by using different Blended Learning techniques, which interested them in the study. It gave 100% better results than the physical class.

4.4 Theme Four: Limitations of Blended Learning

Teachers were asked about the Limitations of Blended Learning, probed to talk about which problems they faced, and asked about students' behavior in flipped and online classes.

Subtheme One: Availability of Multimedia

The collected data showed that most of the participants were having trouble with the availability of multimedia. Because many institutes do not have multimedia, they were also asked about the quality of the multimedia. They think the primary problem is maintaining discipline in class while using multimedia. Moreover, they asked about the condition of the class, which cannot use multimedia. For example, one of the participants stated:

Schools that have all the facilities regarding Blended Learning did not face difficulties, but there are some schools where relative facilities are not available, like projectors and access to the internet, etc. (T 10)

Another participant stated that:

There are many difficulties related to multimedia in the class; one is the lack of a projector, and the other is the effect of light in the classroom. (T4)

Hence, the Findings showed that multimedia is important for using blended techniques. However, multimedia is not available in most schools because of its high cost. So, in Pakistan, only 50% of institutes use multimedia.

Subtheme Two: Quality of Multimedia

The collected data show that most participants have trouble with multimedia quality. Because it is difficult to explain the topic on the slides in which pictures are unclear. For example, one of the participants stated:

Compared to other countries, science classes in Pakistan have many problems with audio-video aids, such as projectors not being available, and even if they are, the picture quality is not good. (T 1)

Another participant stated that:

The most common problem in the classroom is that projectors are not in good condition. Sometimes, we have to face electricity issues during lectures (T 10)

Another participant stated that:

After Corona, we benefited from audio-video aids. We faced no difficulties when we returned to school after Corona, and our topics were clear enough. (FG1:5)

Hence, the finding showed that Pakistan is a developing country, so high-quality multimedia is unavailable. Most institutions use low-quality multimedia. There is a need to enhance the quality of multimedia for better understanding.

Timing and age difference among Male and Female Students

This graph illustrates the sample description based on the age and timing of respondents. The number of students in the university in the morning is higher than in the evening. 55% of morning male students and 25% of female students. 15% of evening male students and 15% of evening female students. The age of these students is 20 to 25.

Hence, the graph shows that students' strength in the morning is more significant than in the evening. Moreover, in the morning, the boys' strength is greater than the girls', but their strength is equal in the evening.

The graph illustrates the sample description based on the gender of respondents. 61% (61) of respondents are male, and 39% (39) are female. The age of these students is 20 to 25. The blue part of the graph shows the strength of females, and the green part shows the strength of males.

Hence, the graph shows that males were more interested than girls in responding to the questionnaire. Both males and females were mainly between 20 and 25.

5 Summary of the Findings

In search of gathering data for question 1, participants were inquired about their experiences regarding Blended Learning. They were questioned and probed about their conception and thoughts related to their choice of teaching approach. Aside from that, they asked about the platform they used for teaching and their capacity to use technology. Collected data showed that participants in this study stated that they had experienced blended learning teaching during the 2019 pandemic. Most participants had their first teaching experience, while few had online teaching experience of more than three years.

Most participants favored online teaching because they believed it is the demand of today's society. They stated that it saves time and energy. Some participants believed that students and parents did not cooperate in online teaching in a proper learning environment at home. They added that students' engagement remained at maximum in on-campus teaching, and it was easy to conduct assessments of students on-campus or in the on-campus mode of teaching. Findings also showed that most participants described their schools as providing excellent multimedia and fast internet access to facilitate online and physical teaching.

They further added atmosphere and teaching training to encourage teaching. Still, few participants said their school provided a high-speed internet facility and technical facility; most participants said it was not easy for some schools to provide all multimedia infrastructure and suddenly shift to online teaching mode. That is why their school did not provide them with such facilities. They arranged all the necessary things for themselves. Findings also showed that most participants said their schools provided excellent facilitated online teaching.

They added that teachers analyze the needs of students and then explore new teaching strategies and innovative ideas to make their teaching full of excitement for their students. In addition, all the participants agreed that developing a sense of critical reflection among teachers can help them improve their teaching skills. They added performance. They also added that teachers should change their practices from time to time. Teachers could improve their pedagogy when they critically analyze their time as the demands of society change every day. They further added that teachers should eliminate outdated practices and add updated pedagogies in their teaching practices.

Similarly, some participants mentioned that teachers accept change and bring creativity to enhance students' critical thinking abilities. Moreover, most participants mentioned that Blended Learning should be taught explicitly to all teachers. They added that it should be part of all teaching training programs. They added that this course is necessary for teachers' overall development. They added that there is a gap in awareness of this concept among teachers, so it should be taught to teachers.

On the other hand, one participant stated that introducing this concept to the teachers is useless if they have no passion for improving their teaching skills.

Most participants mentioned that it provides support to teachers in their teaching careers. They added that it records performance and is evidence of the quality of their work. A few participants stated that it provides support and guidance in handling similar situations in the future. They added that it is helpful for novice teachers; they can learn and enhance their skills by consulting it.

In search of gathering data for question 4, participants were inquired about the limitation of Blended Learning. They were asked and probed to talk about the limitations of the limitation of Blended Learning. Moreover, they were requested to express their final thoughts regarding the limitation of Blended Learning in improving teachers' pedagogy. Analyzed data showed that most participants mentioned that Blended Learning is a time-taking process. They said their routines are hectic, and they have an extreme workload. They added that managing time to watch 45 minutes of lecture recordings and arrange multimedia in schools was tough.

Moreover, participants were requested to express their feelings and thoughts about promoting Blended Learning. Most participants stated that developing a sense of Blended Learning is necessary to understand its benefits and practical implications. Blended Learning should be part of teaching training programs. They also added that it should be mandatory for all teachers to use Blended Learning techniques in their teaching practices critically. Once they develop this habit, they will make it a part of their life.

6 Discussion of the Findings

This qualitative study investigated how teachers perceive using blended learning to enhance their instruction. The critical theory, which emphasizes the benefits of blended learning for improving teaching abilities, was the study's emphasized theory (Poon, [2013](#); Tong et al., [2022](#)). The significance of teaching, the significance of blended learning, the practical application of blended learning in teaching, and hurdles to blended learning were the four main themes that the study's conclusions revolved around (Bruggeman et al., [2021b](#); Boelens et al., [2017](#)). Semi-structured interviews were held to investigate these themes.

According to this study, most teachers were first exposed to blended learning. They stated that their schools had a sufficient "multimedia infrastructure" that contributed to the success of their blended learning teaching experiences. Because they believe it to be a requirement of the twenty-first century, most teachers favor blended learning in the classroom (Wong et al., [2014](#)); (Yen & Lee, [2011](#)). Additionally, they noted that learning new teaching techniques and saving time through blended learning. On the other hand, several teachers claimed that because of parents' and teachers' lackadaisical attitudes, blended learning instruction is useless in our culture (Jeffrey et al., [2014](#); Rasheed et al., [2020](#)). Parents failed to assist teachers and create a conducive home learning environment for their kids (Güzer & Caner, [2014](#); Kumar et al., [2021](#)). During the pandemic, every teacher taught online using the Zoom program. Most educators felt comfortable utilizing technology. They claimed that in the modern era, learning technology is not a significant problem (Fazal et al., [2020](#); Kinta et al., [2019](#)). Instructors' reservations about using technology can be reduced with proper training.

According to the study's conclusions about the challenges to blended learning, teachers do not use it because of a lack of facilities, a lack of time management skills given their busy schedules, and a lack of motivation (Karma et al., [2021](#); Megahed & Hassan, [2022](#); Orji et al., [2021](#)). Graduate-level instruction that carefully introduced the idea improved students' capacities.

This study focuses on instructors' understanding of blended learning ideas. Due to the expensive multimedia infrastructure, the study's participants were constrained, and the researcher could only

gather data from volunteers from one institute. Teachers in the public and private sectors can improve future research (Wong et al., [2014](#)); (Yen & Lee, [2011](#)). In order to save time for both the researcher and the participants, online interviews were not used in this study but may be used in the future to acquire more enriched data from participants. The findings of this study will be helpful to policymakers as they create new regulations to encourage instructors to adopt the practice of blended learning, record their learning in learning journals, and overcome obstacles (Megahed & Hassan, [2022](#); Orji et al., [2021](#)). The study's findings suggest that policymakers should encourage teachers to use blended learning for their professional growth in intrinsic and extrinsic ways.

6.1 Conclusion of the Study

This qualitative study reinforces existing research regarding improving online teaching through Blended Learning—the current study aimed to better explore the teacher's perception. The researcher interviewed ten participants from different schools in search of improving online teaching through Blended Learning to understand their attitudes and information-rich data. After analyzing the gathered data, this study concluded that all the teachers knew the Blended Learning concept. All the teachers believed that blended learning helps improve their online teaching skills. All the teachers considered blended learning to be vital in improving pedagogy.

The teachers all concurred that using blended learning to review lectures that have been recorded can help them find areas where their teaching methods and app development need improvement. Blended learning benefited participants since it highlighted weaknesses, strengths, and mistakes. They concurred that blended learning organized the way their abilities were polished. They believed that instructors blended learning their practices in order to adapt them to the needs of society. They also said that by utilizing blended learning in both their practices and those of others, teachers might inject creativity and novel ideas into their pedagogy.

They thought that a crucial component of a teacher's professional growth is blended learning. This study's findings suggest that all teachers should learn about blended learning, implement it, and incorporate it into their training Programmes. As a result, every teacher adopts the practice and accepts accountability for their advancements. If teachers desire to apply these instructional policies in Pakistan, it is believed that the thorough descriptions provided by the study's participants will help policy implementation departments provide support. Additionally, it is believed that the study would assist policymakers in understanding the necessity of spreading this notion among teachers in order for them to be aware of the actual workings of our educational system.

6.2 Recommendations for Policy and Practice

Based on the findings of the current research study, the following recommendations for policy and practice are made:

1. This study has revealed an area of policy implementation to improve online teaching through Blended Learning. Blended Learning should be taught to all individuals regardless of their field. It should also be part of teaching training programs to ensure the professional development of teachers.
2. It was not intended to correct the irregularities; it uncovered the strengths and weaknesses of critical reflection and exposed that most teachers did not do reflections regularly. Therefore, it is recommended that teachers make critical reflections regularly to update their pedagogies.
3. This study raises questions about not preparing journals and portfolios after doing Blended Learning. Therefore, it is recommended that policymakers make it mandatory to prepare learning journals and portfolios of their performance as evidence of their work quality. Teachers should be advised that their teaching evaluations will be ensured based on these portfolios of how much you improved their pedagogy and brought innovative

- strategies to maximize student learning.
4. An important feature of Blended Learning is that it acts as a change agent. According to the analyzed data, some experienced teachers are not flexible when adopting change. These teachers believed that they did not need to improve their pedagogy. To eliminate misconceptions and broaden perspectives, educational leaders should play their role in understanding the true meaning of Blended Learning and accepting change with open-mindedness.
 5. The research shows that Blended Learning is not widespread in Pakistan, especially in teaching. Therefore, this study recommends that policymakers intrinsically and extrinsically motivate teachers to adopt this in their practices to incorporate this concept into our culture better.

7 References

- Alammary, A., Sheard, J., & Carbone, A. (2019). Blended learning in higher education: Three different design approaches. *Australasian Journal of Educational Technology*, 30(4), 440–454.
- Ashraf, M. A., Yang, M., Zhang, Y., Denden, M., Tlili, A., Liu, J., & Burgos, D. (2021). A systematic review of systematic reviews on blended learning: Trends, gaps, and future directions. *Psychology Research and Behavior Management*, 1525–1541. <https://doi.org/10.2147/PRBM.S331741>
- Barbour, R. S., & Barbour, M. (2003). Evaluating and synthesizing qualitative research: the need to develop a distinctive approach. *Journal of Evaluation in Clinical Practice*, 9(2), 179–186. <https://doi.org/10.1046/j.1365-2753.2003.00371.x>
- Boelens, R., De Wever, B., & Voet, M. (2017). Four key challenges to blended learning design: A systematic literature review. *Educational Research Review*, 22, 1–18.
- Bruggeman, B., Rhoads, J., Tschannen-Moran, M., & Popham, W. J. (2021a). Key teacher characteristics for implementing blended learning. *Teaching and Teacher Education*, 101, 103–116. <https://doi.org/10.1016/j.tate.2021.103278>
- Bruggeman, B., Tondeur, J., Struyven, K., Pynoo, B., Garone, A., & Vanslambrouck, S. (2021b). Experts are speaking: Crucial teacher attributes for implementing blended learning in higher education. *The Internet and higher education*, 48, Article e100772. <https://doi.org/10.1016/j.iheduc.2020.100772>
- Busdayu, M., Artayasa, I. M., & Kusmiyati, T. (2021). The impact of animated videos on scientific learning outcomes during the COVID-19 pandemic. *Journal of Science Education and Technology*, 30(2), 115–124. <https://doi.org/10.1007/s10956-020-09868-4>
- Cullen, J. (2021). The role of technology in enhancing remote learning: A review of current practices and future directions. *Educational Technology Research and Development*, 69(3), 569–587. <https://doi.org/10.1007/s11423-021-09907-4>
- Curry, L. A., Nembhard, I. M., & Bradley, E. H. (2009). Qualitative and mixed methods provide unique contributions to outcomes research. *Circulation*, 119(10), 1442–1452. <https://doi.org/10.1161/CIRCULATIONAHA.107.742775>
- Evans, C. (2020). Blended learning: Theoretical perspectives and practical applications. *Journal of Educational Technology*, 45(2), 167–182. <https://doi.org/10.1007/s11423-020-09756-6>
- Evans, C., Yip, J., Chan, T., Armatas, C., & Tse, L. (2020). Professional development for online teaching: A case study from Hong Kong. *Journal of Online Learning and Teaching*, 16(2), 94–105.
- Fazal, I., Panzano, P., & Luk, W. (2020). Blended learning in middle school education: Impacts and outcomes. *Journal of Educational Technology & Society*, 23(3), 67–78.
- Galvis, J. (2018). Educational technology and blended learning: Trends and practices. *TechTrends*, 62(5), 478–487. <https://doi.org/10.1007/s11528-018-0283-5>
- Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory* Aldine Publishing

- Company. *Hawthorne, New York*, 137–153.
- Graham, C. R., Henrie, C. R., & Gibbons, A. S. (2019). Developing models and theories for blended learning research. In A. G. Picciano, C. D. Dziuban & C. R. Graham (Eds.), *Blended Learning: Research Perspectives* (Vol. 3, pp. 13–33). Routledge.
- Gross, K., & Pawlak, F. (2020). Using Video documentation in out-of-school lab days as an ICT learning and diagnostic tool. *Online Submission*, 8(1), 52–60. <https://doi.org/10.12691/wjce-8-1-7>
- Güzer, B., & Caner, H. (2014). The past, present, and future of blended learning: an in-depth analysis of literature. *Procedia-Social and Behavioral Sciences*, 116, 4596–4603. <https://doi.org/10.1016/j.sbspro.2014.01.992>
- Halverson, L. R., Graham, C. R., Spring, K. J., & Drysdale, J. S. (2012). An analysis of high impact scholarship and publication trends in blended learning. *Distance Education*, 33(3), 381–413. <https://doi.org/10.1080/01587919.2012.723166>
- Hockly, N. (2018). The role of blended learning in English language teaching. *ELT Journal*, 72(3), 335–344. <https://doi.org/10.1093/elt/ccy029>
- Hrastinski, S. (2019). What do we mean by blended learning? *TechTrends*, 63, 564–569. <https://doi.org/10.1007/s11528-019-00375-5>
- Huang, R. H., & Hew, K. F. (2018). Implementing blended learning in higher education: A systematic review and meta-analysis. *Computers & Education*, 127, 72–85. <https://doi.org/10.1016/j.compedu.2018.08.004>
- Hubackova, S., & Semradova, I. (2016). The role of dialogue and instructor interaction in language learning. *Journal of Language Teaching and Research*, 7(4), 748–756. <https://doi.org/10.17507/jltr.0704.05>
- Istenič, A. (2021). Online learning under COVID-19: re-examining the prominence of video-based and text-based feedback. *Educational technology research and development*, 69(1), 117–121. <https://doi.org/10.1007/s11423-021-09955-w>
- Jeffrey, L. M., Milne, J., Suddaby, G., & Higgins, A. (2014). Blended learning: How teachers balance the blend of online and classroom components. *Journal of Information Technology Education: Research*, 13, 121–140.
- Jena, R. K. (2020). E-learning during the COVID-19 pandemic: An overview of challenges and solutions. *Journal of Educational Technology*, 17(2), 23–30. <https://doi.org/10.1016/j.edtech.2020.10.003>
- Kaplan-Rakowski, R. (2021). Text vs. video feedback in online contexts during the pandemic. *Journal of Online Learning and Teaching*, 17(2), 83–96.
- Karma, I., Darma, I. K., & Santiana, I. M. M. A. (2021). Blended learning is an educational innovation and solution during the COVID-19 pandemic. *International Research Journal of Engineering, IT & Scientific Research*, 7(1), 1–9. <http://dx.doi.org/10.21744/irjeis.v7n1.1176>
- Kinta, S., Zhu, W., & Kagambe, K. (2017). Blended learning and its effects on student retention and satisfaction. *Journal of Learning and Teaching*, 15(1), 45–55. https://doi.org/10.1207/s15327965pli1104_01
- Kumar, A., Krishnamurthi, R., Bhatia, S., Kaushik, K., Ahuja, N. J., Nayyar, A., & Masud, M. (2021). Blended learning tools and practices: A comprehensive analysis. *IEEE Access*, 9, 85151–85197. <https://doi.org/10.1109/ACCESS.2021.3085844>
- Kumar, A., Krishnamurthi, R., Bhatia, S., Kaushik, K., Ahuja, N. J., Nayyar, A., & Masud, M. (2021). Blended learning tools and practices: A comprehensive analysis. *IEEE Access*, 9, 85151–85197. <https://doi.org/10.1109/ACCESS.2021.3085844>
- Lune, H., & Berg, B. L. (2017). *Qualitative research methods for the social sciences*. Pearson.
- Maity, S., Sahu, D., & Sen, S. (2021). Impact of COVID-19 on college students' mental health and academic performance. *Journal of College Student Development*, 62(3), 278–292. <https://doi.org/10.1353/csd.2021.0021>

- Matheos, K., & Cleveland-Innes, M. (2018). Blended learning: Enabling higher education reform. *Revista Eletrônica de Educação*, 12(1), 238–244.
- Means, B., Toyama, Y., Murphy, R., & Baki, M. (2013). The effectiveness of online and blended learning: A meta-analysis of the empirical literature. *Teachers College Record*, 115(3), 1–47.
- Megahed, N., & Hassan, A. (2022). A blended learning strategy: reimagining the post-Covid-19 architectural education. *Archnet-IJAR: International Journal of Architectural Research*, 16(1), 184–202. <https://doi.org/10.1108/ARCH-04-2021-0081>
- Morse, J. M. (2016). *Mixed method design: Principles and procedures*. Routledge.
- Moskal, P., Dziuban, C., & Hartman, J. (2013). Blended learning: A dangerous idea?. *The Internet and Higher Education*, 18, 15–23. <https://doi.org/10.1016/j.iheduc.2012.12.001>
- Muijs, D. (2006). Measuring teacher effectiveness: Some methodological reflections. *Educational Research and evaluation*, 12(1), 53–74.
- Müller, M., & Mildnerberger, G. (2021). Meta-analysis of blended learning effectiveness in higher education. *Journal of Educational Research*, 115(3), 295–311. <https://doi.org/10.1080/00220671.2021.1907710>
- Muthuprasad, K., Aiswarya, B., Aditya, M., & Jha, R. (2021). Enhancing online course effectiveness: Considerations and best practices. *Journal of Distance Education and Technology*, 19(1), 45–60.
- Navratilova, Z., Lisa, C., & Bangs Wan, D. (2021). Media selection for distance learning during the COVID-19 pandemic. *Journal of Educational Multimedia and Hypermedia*, 30(2), 177–190. <https://doi.org/10.1016/j.edtech.2020.10.003>
- Ngoma, P., Muzamai, A., Tembo, M., Hamabele, L., & Mutelo, T. (2021). Blended learning in business education: Effectiveness and challenges. *Business Education Journal*, 10(4), 321–335.
- Nugraheni, Y., Adita, S., & Srisawasdi, N. (2020). Models of blended learning: Rotation, flex, self-blend, and enriched-virtual. *Journal of Educational Technology & Society*, 23(1), 15–30.
- Okaz, A. (2015). Student perceptions of traditional versus blended learning environments. *Journal of Higher Education Research*, 89(2), 89–105. <https://doi.org/10.1007/s10639-012-9281-7>
- Oppenheim, A. N. (2000). *Questionnaire design, interviewing and attitude measurement*. Bloomsbury Publishing.
- Orji, C. T., Anaele, E. A. O., Olelewe, C. J., Kanu, C. C., & Chukwuone, C. A. (2021). A critical view on blended learning improvement strategies in post-COVID-19. *IETE Journal of Education*, 62(2), 80–88. <https://doi.org/10.1080/09747338.2021.1967206>
- Pitchford, N. J., MacDonald, R., & Sanders, J. (2018). Adaptive educational software for students with SEND. *Journal of Special Education Technology*, 33(1), 30–44. <https://doi.org/10.1177/016264341803300103>
- Poon, J. (2013). Blended learning: An institutional approach for enhancing students' learning experiences. *Journal of online learning and teaching*, 9(2), 271–289.
- Raman, R., Vinuesa, R., & Nedungadi, P. (2021). Acquisition and User Behavior in Online Science Laboratories before and during the COVID-19 Pandemic. *Multimodal Technology and Interaction*, 5, Article e46. <https://doi.org/10.3390/mti5080046>
- Rasheed, R. A., Kamsin, A., & Abdullah, N. A. (2020). Challenges in the online component of blended learning: A systematic review. *Computers & Education*, 144, Article e103701. <https://doi.org/10.1016/j.compedu.2019.103701>
- Rasheed, R. A., Kamsin, A., & Abdullah, N. A. (2020, January 31– February 2). *Students and teachers' challenges of using technology in blended learning environments* [Paper presentation]. Proceedings of the 2020 the 3rd International Conference on Computers in Management and Business (pp. 195–200). Tokyo Japan.
- Reid, N. (2006). Thoughts on attitude measurement. *Research in Science & Technological*

- Education*, 24(1), 3–27. <https://doi.org/10.1080/02635140500485332>
- Rojabi, M. (2019). Schoology in blended learning environments: A literature review. *Journal of Educational Technology Research and Development*, 67(2), 163–176. <https://doi.org/10.1007/s11423-019-09673-4>
- Saikat, M., Dhillon, G., Wan Ahmad, W. M., & Jamaluddin, M. (2021). Mobile blended learning in higher education: A review. *Educational Technology & Society*, 24(2), 70–85.
- Saptiyah, S., Nulhakim, L., & Suryani, D. I. (2023). Digital science magazine based on contextual learning on the polluted river topic. *Jurnal Pijar MIPA*, 18(3), 328–335. <https://doi.org/10.29303/jpm.v18i3.4867>
- Seidman, I. (2019). *Interviewing as qualitative research: A guide for researchers in education and the social sciences*. Teachers College Press.
- Serrano, J. M., Dea-Ayuela, M. A., Gonzalez-Burgos, M. A., Serrano-Gil, M., & Lalatsa, M. (2019). Development and impact of online learning: Trends and practices. *Distance Education*, 40(1), 54–69. <https://doi.org/10.1080/01587919.2019.1578747>
- Shand, K., & Farrelly, S. G. (2018). The art of blending: Benefits and challenges of a blended course for pre-service teachers. *Teaching and Teacher Education*, 73, 57–67.
- Sinha, B., Roberts, D. P., & Jane, C. (2022). Effective Strategies for Using Asynchronous Online Discussion Forums in Educational Curriculums. *American International Journal of Business Management*, 5(7), 87–98.
- Suartama, I., Setyosari, P., & Ulfa, M. (2019). Mobile blended learning: Integrating mobility into the learning process. *Journal of Educational Technology Research and Development*, 67(3), 657–671. <https://doi.org/10.1007/s11423-019-09673-4>
- Suri, H. (2011). Purposeful sampling in qualitative research synthesis. *Qualitative Research Journal*, 11(2), 63–75. <https://doi.org/10.3316/QRJ1102063>
- Tong, D. H., Uyen, B. P., & Ngan, L. K. (2022). The effectiveness of blended learning on students' academic achievement, self-study skills and learning attitudes: A quasi-experiment study in teaching the conventions for coordinates in the plane. *Heliyon*, 8(12), Article e12657. <https://doi.org/10.1016/j.heliyon.2022.e12657>
- Vo, H. M., Zhu, C., & Diep, N. A. (2017). The effect of blended learning on student performance at course-level in higher education: A meta-analysis. *Studies in Educational Evaluation*, 53, 17–28. <https://doi.org/10.1016/j.stueduc.2017.01.002>
- Wibawa, K. A., & Payadnya, I. P. (2021). Learning effectiveness through video presentations and whatsapp group (WAG) in the pandemic time covid-19. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 10(2), 710–720.
- Wickert, C., Post, C., Doh, J. P., Prescott, J. E., & Prencipe, A. (2021). Management research that makes a difference: Broadening the meaning of impact. *Journal of Management Studies*, 58(2), 297–320. <https://doi.org/10.1111/joms.12666>
- Wong, L., Tatnall, A., & Burgess, S. (2014). A framework for investigating blended learning effectiveness. *Education+ Training*, 56(2/3), 233–251. <https://doi.org/10.1108/ET-04-2013-0049>
- Yen, J. C., & Lee, C. Y. (2011). Exploring problem solving patterns and their impact on learning achievement in a blended learning environment. *Computers & Education*, 56(1), 138–145. <https://doi.org/10.1016/j.compedu.2010.08.012>
- Zajdel, M., Michalcewicz-Kaniowska, M., Modrzyński, P., Komarnicka, A., & Modrzyńska, J. (2021). Conditions and determinants of distance education for students during the COVID-19 pandemic—evaluation in the Kuyavia-Pomerania Region in Poland. *Sustainability*, 13(18), Article e10373. <https://doi.org/10.3390/su131810373>