# New Directions of 5G for the Development of Blended Learning Models

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To improve the quality of education, the application of various forms of teaching and learning tools supported by technology is becoming increasingly widespread in education. Especially the internet communication and technology are changing the education era swiftly with the advent of fifth-generation technology. Research about blended learning (BL) based on 5G networks is emerging. However, few studies have explained how 5G network technology helps the BL teaching model be better applied to teaching. Therefore, this paper tries to sort out the development process of BL teaching mode, summarize the challenges of BL learning in teaching, and explore how the development of the 5G era will positively impact BL teaching mode.

*Keywords:* blended learning, 5G network technology, teaching model, online learning

## Introduction

The rapid development of information and communication technology (ICT) accelerates the pace of the intelligence in various fields. Computer science and artificial intelligence are drawing a foreseeable blueprint for the future educational era. Integrating big data into education brings hope for personalized and differentiated teaching in traditional teaching environments (Fischer et al., 2020). The introduction of artificial intelligence brings the possibility of building smart classrooms empowered by smart devices, intelligent robot teachers, and other realities (Tahiru, 2021; Yang, Oh, & Wang, 2020). These changes have even brought about the emergence of new teaching and learning forms, facilitating pedagogical optimization.

Blended learning (BL) is a new learning model that was proposed on the introduction of technology into traditional teaching. Blended learning combines the advantages of both online and offline instruction, allowing students to enjoy the advantages of online learning in a traditional face-to-face classroom, like optimization of the learning process and access to rich learning resources (Garrison & Kanuka, 2004). Especially the development of 5G technology brought predictable advances in blended learning. For example, high transport rates also mean that data collected by technology can be uploaded and downloaded faster. This makes it easier to do varieties of blended learning that were hard to do before in a 4G network environment, like real-time connections between multiple schools in real-time.

However, few studies have explored how 5G contributes to blended learning and instructional optimization. Therefore, this study explores the challenges of blended learning and explains the impact of 5G

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on the optimization process of blended learning. It is expected that the widespread deployment of 5G is likely to lead to ideas for boosting blended teaching and learning.

## Literature Review

### Blended Learning

With the development of information communication and technology, using technology in the traditional learning environment is becoming common. The blended learning model has attracted the attention of researchers and most teachers attempt to use this learning model in real-life teaching (Grgurović, 2011). While there is no exact definition of blended learning, it is widely accepted that it is the process of using technology to combine the online learning experience with the experience of a traditional face-to-face classroom. Bayram et al. divided BL into three periods, 1999-2002 for the first attempt, 2003-2006 for the definition period, and 2006 to present for the acceptance period (Güzer & Caner, 2014).

The early days of blended learning can be traced back to the 1990s. According to Güzer, the 1990s belongs to the first attempts of BL model (Güzer & Caner, 2014). Blended learning in early years was characterized by applying online elements like games, e-learning materials, or virtual collaborative chat tools to traditional classrooms (Bonk, Olson, Wisher, & Orvis, 2002; Cooney, Gupton, & O'Laughlin, 2000; Voci & Young, 2001). In addition, offline classroom learning is still the mainstream mode in this period (Bonk et al., 2002). The development of technology became the primary block preventing the blended learning model from gaining popularity. Fortunately, it also serves as the cornerstone around which blended learning may be built.

As the field of information and communication technology progresses, more and more tools become available for enhancing the classroom experience. Most technology gaps in the early phases of blended learning development have been overcome by developing technologies. More possibilities exist for the combination of online and offline learning thanks to the proliferation of learning resource platforms, instructional aids, and entertainment software that can be temporarily applied in traditional classroom. One such digital technology, Rain Classroom, may enhance conventional classroom engagement by having the teacher's PowerPoint presentation synced with the student's mobile phone through the internet. Moreover, the PowerPoint quizzes and voting activities improve student-teacher engagement and enliven class time. Also, Kahoot, a game-based online learning platform, has positive implications as a supplement to the traditional classroom by providing students with a platform for review and assessment after class.

Such game-based learning platforms also increase learners' interest in learning (Wang & Tahir, 2020). Clickers, a real-time response feedback technology, may also be used in conventional education to boost students' interest and participation (Martyn, 2007). The excellent trend of incorporating technological tools into conventional classrooms is gathering momentum. This demonstrates how the abundance of technology has contributed to the growth of blended learning methods.

### 5G

As opposed to 4G, the new 5G mobile network technology allows for almost limitless data transfers. The first 5G call was made in 2008 between China Mobile and ZTE Corporation, marking the beginning of the 5G era. Compared to 4G, 5G has several new features. First, 5G uses different kinds of antennas to reduce latency and propagation speed. Second, 5G has a higher frequency radio spectrum, and its radio spectrum can be up to 30 GHZ or more. Finally, the shorter wavelengths of 5G allow for more precise direction and control in

supporting more devices during transmission. Because of its quicker data throughput, more accurate transmission directions, and lower latency, 5G wireless technology may give users with a revolutionary network experience. 5G provides a solid foundation to support the intelligent life sector. In innovative automobiles, for instance, 5G enables the remote, low-latency, high-accuracy control of vehicle services. Much more, 5G networks' rapid data transfer paves the way for the effortless linking of disparate embedded sensors. Fortunately, the education system is equally attentive to the development of these innovations. The widespread use of 5G technology may answers the challenges of the blended learning model. It is crucial to investigate how 5G may revolutionize the blended learning paradigm and its function in facilitating blended learning. For that purpose, the following piece will examine the problems that contemporary blended learning models face and how the advent of 5G technology might be utilized to remedy them.

## Discussion

Blended learning is an approach to education that incorporates the best features of both online and classroom-based education. It satisfies the need for close physical contact between instructors and students and the requirement for a wealth of supplementary learning materials and digital tools to supplement the conventional learning environment. Numerous researchers have come to acknowledge the benefits of blended learning. However, as the study of blended learning expands, its limitations are also becoming apparent.

### Challenge of Blended Learning

**Limitation of network speed.** The blended learning model features the use of digital technology to increase learning efficiency in the traditional classroom. There are three types of blended learning models which are blending of students, blending of teachers, and blending of learning of activities.

The mixing of students refers to mixing students in a traditional classroom with students in online learning. The mixing of teachers refers to the mixing of students in the traditional face-to-face classroom with teachers in a distance online learning environment. The mixing of learning activities refers to blending students' learning activities in the traditional offline classroom and students' learning activities in the online environment. Although the specific modes of the three types of blended learning are different, these are all dependent on the speed of network transmission. Much more emphasis is placed on the real-time interaction between the two parties in this interactive environment.

In comparison, the teachers' and students' learning progress and learning experience are severely affected by the difficulty of the extra-long distance video transmission between the two parties in both directions. The high network latency and the lack of clear image transmission often affect the application of the first two hybrid modes in teaching and learning (Lin, Xie, & Cai, 2019). The network factor is also one of the main influencing factors that currently make this blended learning reach the bottleneck.

**Limitations in the scope of application of the technology.** Online technology tools play a vital role in the blended learning model. Different digital tools are available to assist the traditional classroom in different ways. This study may classify digital technology, which assists the classroom, into three main categories: tools that improve classroom interaction, tools that enhance learning materials, and technologies that aid in classroom evaluation.

The leading classroom interaction technologies facilitate more teacher-student communication in the conventional classroom. Examples include rain classroom, clicker, and social media software with text-based

communication functions. These tools are more commonly used on university campuses. Xiang et al. found that using a built-in mobile app, like Rain Classroom, can help teachers get instant access to real-time student Q & A and facilitate synchronous cross-screen communication (Li & Song, 2018). Lindsay et al. found that using a hand-held response device called a clicker in the classroom increased student engagement and helped students remember content more effectively (Anderson, Healy, Kole, & Bourne, 2011). Resource-rich learning mainly refers to websites like MOOC platforms that gather learning resources in one platform. Teachers help students learn at their own pace outside the classroom by recommending free learning resources on the web. Such free online resources can expand students' sources of learning materials and enrich learners' receptivity to knowledge. The last sort of tool is called aided classroom assessment, and it uses technology to help instructors evaluate students learning result basis on their learning process data in classrooms. The Rain Classroom, for instance, may improve interaction and capture information about students' learning process in real time, like test results. The analysis above shows that the application of technology tools in the traditional classroom is highly valued in blended learning. However, teachers' digital technology tools in the blended learning model are often simple. Most digital tools still have challenges in their application in blended learning models.

## New Changes in Blended Learning Model With 5G Technology Support

5G accelerates change in other industries, such as intelligent transportation and healthcare. The field of education has some sensitivity to these changes. Therefore, in the next section, this study will explore how 5G can have a positive role to play under blended learning supported by technology.

**Building solid technology support for blended learning models.** 5G next-generation communication technology has faster data transfer than 4G. Video transmission has been a challenge in blended learning, particularly for long-distance teacher-student and student-student modes. With the further development of 5G information technology, the video synchronization upload speed will be more stable, and the delay and loss will be mitigated, never maintaining the learning experience of long-distance blended learning. Fluent long-distance communication is also an incentive for organizing blended learning models. Therefore, the arrival of the 5G era builds solid technical support to hinder the blended learning model further.

**5G-enabled VR technology in the education.** Blended learning has become a recognized effective learning model in recent years. This kind of blended learning combines the benefits of online and offline learning, synchronous and asynchronous learning, and offers learners various learning styles (Duhaney, 2004). The analysis revealed that the current blended learning model features a single technological tool and a simple application.

VR is mainly through hardware technology equipment so that users enter a virtual digital environment. There have also been many studies in recent years that have begun to explore ways to introduce VR into the traditional classroom to enable blended learning. Most studies show that, therefore, although VR can provide learners with an immersive, interactive, and authentic learning environment, the use of VR as an assistive tool in teaching and learning still needs to be integrated with the traditional classroom (Li & Cao, 2020).

As for VR teaching, the development of 5G technology offers more possibilities for VR teaching to be applied in real-world teaching. The ultra-high 5G transmission speed extends the application scope of VR in learning and improves the support for high-complexity VR learning scenes. Moreover, from the perspective of educational equity, innovative education in remote areas has long been a concern of researchers. Due to the remoteness and fragile infrastructure, the network's speed can affect the delivery and loading of electronic

resources. 5G technology brings high-speed loading speed and more accurate directional transmission control to break this limitation for intelligent education in remote areas. The high bandwidth of 5G reduces latency to a certain extent, thus improving the VR learning experience. In addition to network speed, 5G also enables further development of VR in intelligent education in remote areas. The increased transmission speed of VR-based devices through 5G connectivity helps students to have a better learning experience of VR-enhanced education.

## Conclusion

Blended learning has attracted the attention of educators because it combines the dual advantages of online teaching and traditional face-to-face classrooms.

However, as the development of blended learning advances, it remains bottlenecked in real-world teaching and learning environments. 5G technology, a new generation of communication technology developed in recent years, seems to provide a breakthrough to break the bottleneck of blended learning mode due to its high speed and accuracy. Especially in recent years, various countries have attached great importance to the development of 5G communication networks and accelerated the pace of further commercialization of 5G. As far as the education sector is concerned, it should also take advantage of this opportunity to use 5G technology to promote the further development of the teaching model. Presently, the application of 5G in education is primarily in theoretical discussion, and actual practice in education is still a long way off. Therefore, this study analyzes the bottlenecks in the current blended learning model and explores whether 5G technology has positive implications for breaking these bottlenecks.

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