



Sixth Information Systems International Conference (ISICO 2021)

# As simple as pressing a button? A review of the literature on BigBlueButton

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## Abstract

BigBlueButton is an open source virtual classroom software. Since this software was released in 2009, many studies have explored how to use it, especially for e-learning. However, to date, there is no published systematic synthesis of the relevant literature on the subject. This literature review appraises the effectiveness of BigBlueButton in educational settings and pulls relevant pieces of information together into a readable format. The main conclusion is that BigBlueButton is intuitive, interoperable with other software and has the potential to positively affect the learning performance of students. Despite the features and functionalities of BigBlueButton, several limitations are apparent: web conference educators have less control over online teaching compared with their face-to-face counterparts, practical subjects are difficult to teach through web conferencing, technical challenges may affect web-conferencing sessions, web conferencing requires skills additional to those of conventional teaching, cultural differences may affect students' attitudes towards web conference-based learning and educators that teach through web conferencing may feel isolated in their role, both geographically and collegially. By reviewing the features, potential impacts and limitations of BigBlueButton, this study contributes to the growing literature on web conferencing systems and provides insights into the role of BigBlueButton in e-learning.

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Peer-review under responsibility of the scientific committee of the Sixth Information Systems International Conference.

*Keywords:* BigBlueButton; e-learning; online education; web conferencing; synchronous communication

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## 1. Background

E-learning has become one of the most topical issues in the education and information systems (IS) literature [1, 2]. Since the accreditation of the first online degree programmes in the 1980s, many education providers have used various software and applications to facilitate e-learning.

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The diffusion of the internet and availability of web-conferencing technologies have enabled educational institutions to establish or expand their distance education programs [3]. More recently, the use of web-conferencing software in distant education and e-learning has grown in popularity owing to the COVID-19 pandemic, which has forced numerous institutions to replace traditional classroom teaching with synchronous and asynchronous e-learning [4].

Digital technologies have provided an alternative to traditional classrooms, ensuring that student–educator interaction is not limited by time and space; thus, students can engage in independent study virtually [5]. Techniques for using information technology and internet tools ranged from exchanging materials by e-mail to more sophisticated video conferencing tools [2]. Technology used in remote education includes applications that allow educators to provide teaching resources to students through learning applications that students can access by entering their authentication details, and applications that facilitate educator–student interlocution through email, forum [6] and social media software [7]–[9]. Web-conferencing applications have enabled educational institutions to make the transition from traditional teaching in the classroom to online teaching seamless [4].

BigBlueButton is commonly listed among the most popular web conferencing applications [4]. It is an open source, web-based, synchronous conferencing tool that provides virtual spaces for real-time sharing of audio, video, slides, chat and screen sharing [10] [2]. Initiated by Blindside Networks in 2008 [11], the service further provides course management, media streaming, video sessions and online interaction [6]. Moreover, it enables educators and students to exchange information through web conferencing, chat, whiteboard and file sharing, thus rendering it suitable for remote learning [12].

Examples of other synchronous e-learning software programs are Zoom, Adobe Connect and Skype [13]. These can be used not only for the delivery of synchronous video sessions but also in various online learning designs [13] [4]. Given the growing variety of e-learning software available in the market, choosing the right technology for remote education has become critical for educational institutions. The choice of e-learning software is important because empirical evidence demonstrates that educational technology influences online learner engagement [14], and that students’ perceptions of the technology used may influence their level of engagement [2].

Digital learning software has the potential to influence classroom dynamics, including students’ motivation, engagement, concentration and enjoyment, and educators’ performance [15]. Despite its benefits, its success depends on the attitudes of both educators and students to educational technology [16]. Whether students and educators use these tools may depend on the degree to which they believe that using them would be effortless. If a digital artefact is not easy to use and the interface is complicated, many people will be hesitant to use it [17]. The developers of BigBlueButton argue that it is easy to use. In fact, the name ‘BigBlueButton’ arose from the initial concept that starting a web conference should be as simple as pressing a metaphorical big blue button [18]. Some educational institutions may be reluctant to adopt web conferencing tools such as BigBlueButton for fear of creating unnecessary complexity for their staff and students. Hence, there is a need to understand the capabilities of web-conferencing systems in general, and BigBlueButton in particular, and their implications for e-learning. This article elucidates these capabilities and implications by reviewing the relevant literature on the subject.

## 2. Methodology

To achieve the objective of this study, a literature review was conducted to appraise the effectiveness of BigBlueButton in educational settings and to synthesize available information on the use of the software for e-learning. To improve rigour, a detailed guideline for conducting a systematic review was followed, stage by stage, as proposed by Dybå and Dingsøyrr [19]. The stages of the guideline are 1) Development of review protocol, 2) Identification of inclusion and exclusion criteria, 3) Search for relevant studies, 4) Critical appraisal, 5) Data extraction and 6) Synthesis [19].

The protocol specified the research questions, the literature search strategy, inclusion and exclusion criteria, and methods of data extraction and synthesis. To ensure that the article selection process was unbiased, the criteria for inclusion and exclusion of articles were specified in advance [20]. Inclusion and exclusion criteria ensured that as many relevant articles as possible were included so that they would yield data relevant to the research. To avoid missing relevant articles, priority was not given to any particular subject domain. Thus, any article that met the set criteria was included. Fig. 1 shows the PRISMA flow diagram for the literature review.

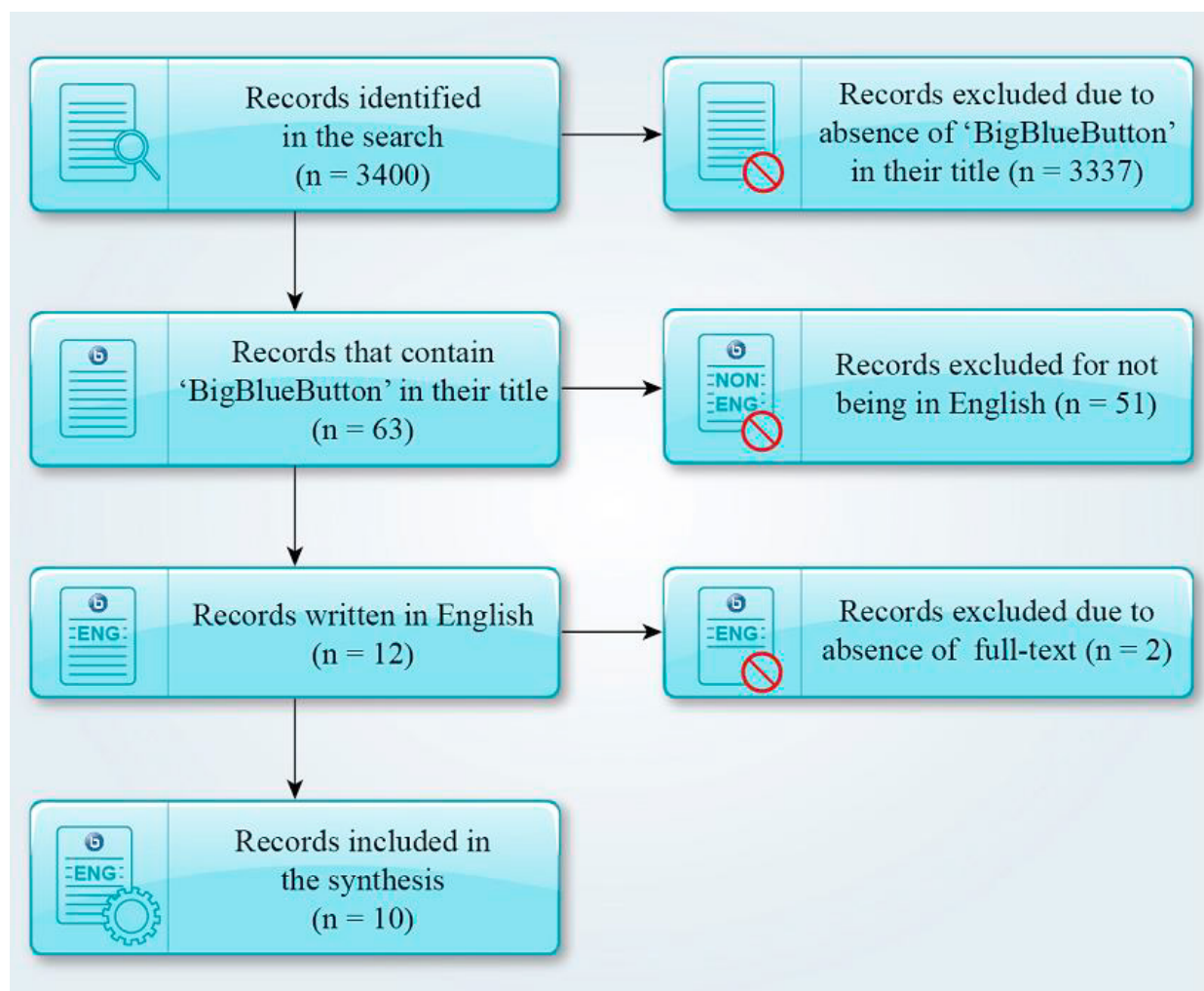


Fig. 1. Flowchart of literature review protocol.

The first version of BigBlueButton was released in 2009. Therefore, only electronic searches were conducted because most relevant publications since then have been electronically indexed. The search for relevant articles involved searching for articles about BigBlueButton on Google Scholar EBSCOhost and Web of Science. The search strings used were 'BigBlueButton' and 'Big Blue Button'. The initial search yielded 3,400 articles. Afterwards, an advanced search was conducted so that only articles that contain the search strings in their titles were included. This process eliminated 3,337 articles; thus, 63 articles remained.

A pragmatic approach was employed in the critical appraisal stage. Certain articles were eliminated, not because of their quality but rather because of practical constraints, such as not being written in the English language. Only relevant articles written in English were retained, as per Fink [21]. This process eliminated 51 articles. From the 12 remaining records, 2 were removed because the full texts were not available online. Thus, only 10 articles were included in the final review.

In the extraction stage, information was extracted from the 10 selected articles after reading them in detail. Information that fell within the scope of this study was extracted. Additional information was extracted from literature on web conference-based learning to supplement the articles initially selected. Finally, information regarding the features of BigBlueButton, as well as the merits and limitations of the system were extracted from relevant articles.

Synthesis involved reviewing the literature on BigBlueButton, and concisely summarizing and linking different sources. Table 1 details the records included in the synthesis.

Table 1. Records included in the synthesis

Author(s)	Title	Country	Focus
Turulja et al. [2]	Engage me through BigBlueButton: Student engagement when attending classes online is the only option	Bosnia and Herzegovina	Understanding the impact of using BigBlueButton on student engagement
Suga [22]	A comparison of bandwidth consumption between proprietary web conference services and BigBlueButton, an open source webinar system	Japan	Comparing bandwidth consumption of BigBlueButton with that of other web conferencing systems
Kumar et al. [23]	An analysis of BigBlueButton remote teaching tool in an Information Systems undergraduate course	Fiji	Understanding the impact of using BigBlueButton on student performance
Čižmešija et al. [4]	An instrument for evaluation of the use of the web conferencing system BigBlueButton in e-learning	Croatia	Developing an instrument for the evaluation of BigBlueButton
Galindo-González [12]	The BigBlueButton in teaching-learning processes, environmental education in ecotechnologies for sustainability	Mexico	Understanding the impact of using BigBlueButton on teaching and learning
Basar et al. [24]	Learning of laboratory project-based learning (LIPBL) on subject of hardware basic computer cloud server real time communication video conference based on BigBlueButton	Indonesia	Addressing educational challenges through the use of BigBlueButton
Han [6]	A fundamentals of financial accounting course multimedia teaching system based on dokeos and BigBlueButton	China	Understanding the impact of BigBlueButton on e-learning
Nagel [11]	MoodleCloud expands BigBlueButton web conferencing options	United States	Integrating BigBlueButton with other applications
Rajasekaran [25]	English language teaching and assessment Using BigBlueButton & Moodle: An observation study	Sri Lanka	Understanding the impact of using BigBlueButton on teaching and assessment
Kiss [10]	Comparison of traditional and web-based education-case study BigBlueButton	Hungary	Comparing students' performance in traditional classrooms with BigBlueButton-based classrooms

### 3. Features of BigBlueButton

The features and functionalities of BigBlueButton render it an efficient tool for e-learning. For example, the tool contains several elements that support interactivity [12]. BigBlueButton is an HTML5 client, which – when used in Firefox and Chrome browsers – delivers high-quality, low-latency WebRTC audio [4]. Its components include a voice conference server, a desk-sharing application program and a web-conferencing program, among others. Further, BigBlueButton enables real-time interaction through Flash language [6].

BigBlueButton is collaborative software with which users can share audio, video, screen, presentation slides, white board and chat facilities, all in real time [4]. The software allows audio and video conferencing, screen sharing, live chat, audience polling, file sharing and meeting recording [4]. It allows presenters to load presentations in PDF or other file formats, synchronize everyone with their current page, zoom and pan. Students can also see the educator's mouse pointer [10] [1] [2]. All participants can share their webcam at the same time, without limits on the number of simultaneously active webcams [10], and the presenter can share a desktop with all participants [2]. The system supports Voice over Internet Protocol conferencing, and participants require speakers and microphones to participate [10] [2]. There is no limit to the number of webcams that can be shared in one session, unless limited by bandwidth [4] [22].

There are two types of users – moderators and viewers. Moderators control the session by assigning and, if necessary, removing user options. The moderator can appoint any user as a presenter, mute or unmute users, or expel users that misbehave from a session [4]. The educator moderates a session by giving permission to one or more students to speak or share their screen or video from time to time [12].

An interesting feature of BigBlueButton is the whiteboard, which educators use to annotate the most important aspects of their presentation [4]. The whiteboard can be used to highlight, zoom, draw and write [4], and it permits students and educators to see and hear each other and share their desktop or window in real time, allowing students the opportunity to deliver their presentations or raise questions [12].

#### 4. Impact of BigBlueButton

An increasing number of people prefer online study to face-to-face delivery because of life and work demands [6]. BigBlueButton is a panacea for problems associated with remote education, including poor interaction and student engagement [6]. E-learning based on BigBlueButton has become popular because of its interoperability, diversified functions, simplified operation and high scalability [10] [6].

It is simple to integrate BigBlueButton with other applications [24]. For instance, the software can be integrated as a plugin to various types of learning management systems, including Moodle, SmartClass, IServ and Sakai [11] [4]. For this reason, BigBlueButton is popular with institutions that use Moodle [4]. Many users perceived BigBlueButton as interesting and easy to use; thus, they are satisfied with the functional and technical aspects of the system [4]. This is important because technology-related factors affect student engagement [2].

BigBlueButton can facilitate remote education by removing the limitations imposed by time and distance [6] [12]. It enables users to conduct meetings remotely via the internet [4]. BigBlueButton users can interact with other interlocutors during a session using a microphone and/or a webcam [4] [12]. Further, it allows synchronous audio and video communication between or among students and educators, enabling timely feedback and collaborative learning [4] [12].

The features and functionalities of BigBlueButton may help improve student outcomes. At any time during a BigBlueButton session, the educator can download a list of students attending the session [4]. Tracking attendance patterns enables educators to identify students at risk of failing or dropping out of study. Further, the features of BigBlueButton that support polling and breakout rooms can enhance engagement and collaboration during online sessions [4]. Students that use BigBlueButton may perform better academically since they are eager to take part in virtual lessons because of its novelty and because it provides them with the flexibility to study from anywhere [10] [23]. Another benefit of BigBlueButton is that it allows sessions to be recorded, and hence students can watch them as many times as they like, based on their needs [26] [12] [4]. Consequently, students who use BigBlueButton often gain the knowledge and skills necessary for work in their area of specialization [12].

Users predominantly have positive attitudes towards web conferencing in general [27][28][16], and BigBlueButton in particular [10] [4] [25]. However, many still prefer the conventional classroom setting [16]. This suggests that the ability of BigBlueButton to support learning is limited.

#### 5. Limitations of BigBlueButton

Despite the benefits inherent in the use of BigBlueButton for e-learning, a number of limitations exist. However, these limitations are true of most video-conferencing systems used for e-learning and are not peculiar to BigBlueButton. Compared with face-to-face teaching, educators have less control over online teaching [2]. Many students would like classes to be more interactive, but many are of the opinion that the educator cannot adequately control the class using the web-conferencing delivery method [3]. Further, practical subjects are difficult to teach using BigBlueButton, which creates a disjoint between teaching and practice [6]. Given that students' perceptions of the quality of online learning are influenced by the degree of course rigour, online learning may negatively affect student engagement [29] [2].

Technical challenges may affect sessions on BigBlueButton and cause the cancellation of scheduled sessions. Occasionally, camera issues, system freeze, bandwidth problems and audio issues disrupt web conferencing-based class sessions [30]. Constant maintenance is needed to prevent technical problems. Such maintenance of e-learning systems involves employing professional personnel to regularly monitor and repair the system. This process can be both expensive and time consuming [31], rendering the provision of distance education using web conferencing a costly exercise [3].

Teaching through BigBlueButton is arguably more demanding than face-to-face teaching. Web conferencing requires additional skills to those of a conventional classroom educator. Teaching by web conference involves more complex planning, preparation and professional development [30]. To impart knowledge to students successfully,

educators availing themselves of this mode of delivery require both technical and soft skills, [3]. Technical skills are required for managing the technology, while soft skills are needed for effective presentation and communication with students. Excellent educators who do not have relevant technical skills may be less efficient in e-learning environments.

Moreover, learning through web conferencing may not be suitable for all students. Cultural difference raises the possibility that some students may not be comfortable with democratic online environments in which everyone may speak freely [32] [3]. Further, students from cultural backgrounds where face-to-face communication is the norm may neither participate actively nor contribute to class discussions in web-conferencing sessions [3].

BigBlueButton-based classes require disciplined adherence to time. Synchronous web conferencing is temporally dependent because participants must come together at exactly the same time [30]. Lack of punctuality for online sessions by students could result in delayed sessions and disruptions to agreed timetables [3]. Thus, timely communication between educators and students is critical to the success of web-conferencing-based e-learning initiatives [33].

A potential unintended outcome of e-learning using BigBlueButton is the possibility of users feeling isolated. One study found that many educators who teach through web conferencing felt isolated in their role, both geographically and collegially [30]. Web conference educators felt that they were not receiving sufficient opportunities for professional development and face-to-face collaboration with colleagues to share strategies and discuss best practice [30]. Strong collegiality in educational settings stimulates enthusiasm among educators and reduces emotional stress and burnout [34]. Conversely, isolation and lack of collegiality among educators may lead to increased dissatisfaction.

## 6. Discussion

One of the focal points of this paper is to appraise the effectiveness of BigBlueButton web-conferencing software in educational settings. Twine and Brown [35] proposed the use of DeLone and McLean's [36] IS success model to appraise the effectiveness of web-conferencing tools. The components of the model are 'information quality', 'system quality', 'service quality', 'intention to use', 'user satisfaction' and 'net benefits' (see Fig. 2). Information quality, system quality and service quality influence both intention to use and user satisfaction [35]. Intention to use influences and is influenced by user satisfaction, and both influence and are influenced by net benefits [35].

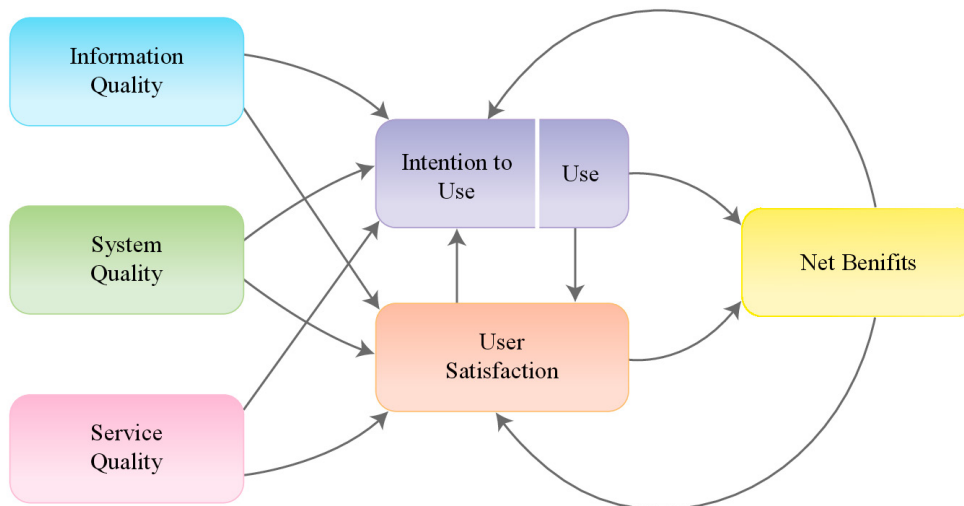


Fig. 2. DeLone and McLean [36] Updated IS success model.

Information quality is appraised in terms of the five traits of quality data – accuracy, timeliness, completeness, relevance and consistency of information provided [36] [35]. The BigBlueButton web-conferencing tool enables the sharing of high-quality data and information and provides variety and information richness to participants [10] [6]. The audiovisual capability of BigBlueButton renders it a suitable substitute to face-to-face communication and, by extension, physical classrooms.

System quality is appraised in terms of integration, ease-of use, flexibility, functionality, reliability, portability, data quality and importance [36] [35]. Additional criteria for appraising system quality are scalability, availability and security [35]. According to the literature reviewed [10] [2], BigBlueButton scores highly in the majority of these areas.

Service quality influences the intention to use, or continue to use, an information system [36]. Timely technical support must be provided to users of web-conferencing software to ensure that its service quality is optimum [35]. Correspondingly, a lack of support for users of BigBlueButton could potentially lead to dissatisfaction, and abandonment. Many users of BigBlueButton report that they face technical challenges intermittently [6, 4]. Therefore, there is a need to provide adequate support to users, including educators and students, to avoid a backlash.

The intention to use component refers to users' desire to use technology in the future [36]. BigBlueButton must be used before it yields the expected benefits. Measures of system-use include frequency of use, time of use, patterns of use and usage dependency [36] [35]. The intention to use BigBlueButton is strong; hence, many users employ it regularly and depend on it for their teaching or learning. Together, intention to use BigBlueButton and its actual usage in organizations is indicative of its effectiveness [35].

Regarding user satisfaction, BigBlueButton is understood as a solution to certain barriers that hinder students' access to education, and many users appear to be satisfied with the software [27] [28] [16]. User satisfaction can be ascertained by exploring satisfaction in terms of both process and outcomes, as well as fairness of and confidence in solutions [35].

BigBlueButton may have both positive and negative impacts in educational settings. Therefore, when appraising BigBlueButton, one needs to consider its net benefits. Net benefits refer to the sum of positive individual, group and organizational impacts [36] [35]. Despite the limitations of BigBlueButton, the literature reviewed indicated that it can positively support e-learning.

## 7. Conclusion

This paper appraised the effectiveness of BigBlueButton in educational settings and synthesized available information on the use of BigBlueButton for e-learning. Several conclusions were reached after reviewing the relevant literature. BigBlueButton is relatively straightforward to use; it is interoperable with other software and easy to integrate with a variety of learning management systems; it eliminates barriers to educational participation created by time and distance; and it could improve student outcomes by enabling the tracking of student attendance, recording and playback of sessions, and collaboration during online sessions.

Despite the effectiveness of the BigBlueButton conferencing system in supporting e-learning, several limitations are apparent. Web conference educators have less control over online teaching compared with their face-to-face counterparts, practical subjects are difficult to teach through web conferencing, technical challenges may affect web-conferencing sessions, web conferencing requires additional skills to those needed for conventional teaching, cultural differences may affect students' attitudes towards web conference-based learning and, finally, educators who teach through BigBlueButton may feel isolated in their role, both geographically and collegially. By reviewing the features, potential impact, and limitations of BigBlueButton, this study contributes to the growing literature on web conferencing systems and provides insights into the role of BigBlueButton in e-learning.

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