

Article

Constructing an Online Sustainable Educational Model in COVID-19 Pandemic Environments

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Abstract: The outbreak of COVID-19 forced billions of learners to stay at home in order to receive online education. The aim of the study is to construct an online sustainable educational model to facilitate this learning approach. This study included 53 peer-reviewed articles for the review study following the selection process of the Preferred Reporting Items for Systematic Review and Meta-analysis Protocol (PRISMA-P) and the clustering techniques of VOSviewer. It is concluded that the model consists of online educational platforms, online assessment systems, social media, and digital literacy. With these features, online education could be sustained. However, challenges should also be addressed to sustain online education during the pandemic. Designers, scientists, and teachers should make every effort to increase learning engagement, enhance learning supervision, formulate adequate emergency programs, minimize educational inequalities, solve technical issues, and formulate systematic learning management and organization. The sustainable online educational model may be updated and perfected by including more practical features in the future.

Keywords: online sustainable educational model; online education; COVID-19; pandemic; environment



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1. Introduction

Coronavirus Disease 2019 (COVID-19) has exerted a seriously negative influence on educational environments [1]. United Nations Educational, Scientific and Cultural Organization (UNESCO) reported that the pandemic has negatively influenced more than 90% of students across the world. More than one billion learners failed to receive traditional instruction due to the shutdown of universities and schools [2,3]. Newly rising countries have suffered more from the pandemic [4,5]. The families with lower economic status have also been cornered due to the lockdown of the economy [6,7], contributing to digital inequalities [8]. Exclusion and inequality have also been exacerbated among vulnerable people, e.g., minorities, the disabled, and the poverty-stricken [9].

The long-term lockdown of universities and schools has resulted in many negative results, e.g., the disengagement of education and psycho-social disadvantages. With the outbreak of COVID-19, numerous universities and schools were forced to shut down. Online education has become the prioritized method. In the USA, college students receiving online education in 2016 stood for 31.6%. In Canada, 76.0% of higher educational institutes delivered lectures using online platforms in the year 2019; this online trend has become increasingly popular since the outbreak of the COVID-19 pandemic. According to the statistics of the United Nations Educational, Scientific and Cultural Organization (UNESCO), approximately 172 countries, over 1.5 billion learners, or around 90% world's students have been forced to receive online learning [10].

The research problem is how do we facilitate online education. It has become an urgent issue in the online environment [11]. The pandemic radically changed the educational environment, where teachers were required to adopt digital technologies, innovate their outdated teaching methods, and adapt to the new educational environment to sustain their teaching career [12]. Online education, possibly the main educational format for a long time, has gained researchers' attention.

Online education may be an effective way to help students and teachers through this unpredictable dilemma [13]. Increasingly more educational institutes have become aware of the virtual education environment where students tend to be of a great variety. Educators need to cater their courses, styles, and schedules to the diversified needs of virtual students. The COVID-19 pandemic has made online learning gain prominence in Vietnam where policymakers and educators have paid much attention to online learning [14]. However, online learning has been confronted with many challenges. The question of how to sustain this emergency teaching and learning format has become urgent for educators to address.

The aim of this study is to establish an innovative online sustainable educational model in the COVID-19 pandemic environment consisting of online educational platforms, online assessment systems, social media, and digital literacy. Sustainable education refers to a form of education where students can adapt to new educational environments and accept the changes occurring in an ecosystem in which they live and learn. Students can change from their traditional learning style to a new one without decreasing learning effectiveness. Teachers can accept and revise their teaching methods without weakening teaching effectiveness. Both teachers and students may address the challenges by taking advantage of them or changing them to benefits in the new educational model [15].

Several online educational models have recently been established. For instance, an online learning model in andrology includes scientific writing projects, student-centered management, weekly formative assessments, and weekly online meetings [16]. Massive Online Open Courses (MOOCs) are considered an effective educational model [17]. Cooperative learning and virtual experiments are deemed as an effective online educational model to improve foundational scientific practices [18]. The online education model includes several critical factors, i.e., intrinsic and extrinsic motivations, learner engagement, and learner satisfaction [19]. Online learning in Saudi Arabia can include four core elements, i.e., educational impact, time management, disadvantages encountered, and future preferences [20]. The above models are different from those in the current study that includes critical elements to cope with the lockdown dilemma (Table 1). For instance, most of the previous online educational models failed to combine social media with online assessment systems and digital literacy to improve online educational outcomes.

Table 1. A comparison between the current study and recent studies.

N	Elements in Recently Established Models	Elements in the Current Model
1	Writing projects, a student-centered approach, weekly formative assessments, and weekly online meetings [16]	Online educational platforms, online assessment systems, social media, digital literacy and challenges
2	Students' engagement, experience, technology anxiety, and facilitating conditions [17]	
3	Cooperative learning and virtual experiments [16]	
4	Intrinsic and extrinsic motivations, learner engagement, and learner satisfaction [19]	
5	Educational impact, time management, disadvantages encountered, and future preferences [20]	

The research objective of this study is to construct an effective and sustainable online educational model. Specifically, the cognitive goal is to establish a model that can effectively sustain and improve online education. The utilitarian goal of this study is to establish a model that can guide or sustain online learning and teaching practice in the future.

2. Literature Review

2.1. Online Platforms to Sustain Online Education

Online educational platforms have become increasingly popular during the COVID-19 pandemic. The pandemic has radically changed the attitudes of students and teachers towards online learning. They have to accept the new educational model where technologies such as online platforms play an important role in distance or online education irrespective of their preferences. Whether or not they have enough digital literacy, they have to adapt themselves to this technology-assisted online environment. By using online learning platforms, teachers and students could maintaining social distance to contain the COVID-19 pandemic. Teachers could prepare lectures, implement online pedagogy, and assign tasks to students at home by using an online learning platform during the pandemic [21]. Teachers tend to produce their lectures on online learning platforms such as Google Classroom to teach veterinary anatomy and they update their digital literacy to meet the new needs of students and lecture delivery [22]. Teachers could also show themselves on the screen to simulate real face-to-face lecturing. Students could interact with them by raising or answering questions and joining in on the discussion by using the platform. The researchers, thus, propose a research question, i.e., are online educational platforms an essential construct in the online sustainable educational model?

2.2. An online Assessment System to Sustain Online Education

An online assessment system could be designed to assess typing skills and the cognitive loads. Typing skills may impact online communication. Good typing skills may facilitate online communication, while poor typing skills may hinder online communication [23]. The assessment of typing skills is, thus, important to evaluate the online effectiveness and sustain online environments [24]. It is also important to measure the cognitive loads of both students and teachers in the online learning environment. The cognitive loads might be under the influence of various factors such as Internet connectivity, access to learning resources, the usefulness of resources, ease of use of online platforms, and teacher's timely feedback [25]. It is thus important to measure both typing skills and the cognitive loads by using an online assessment system.

An online assessment system could sustain online education during the pandemic. It is important to measure online learning attitudes, interest, satisfaction, and effectiveness regarding the abrupt shift to online education [26]. The reliable online assessment instead of traditional paper–pencil examinations is considered important to sustain the new online education. Based on the assessment results, designers and teachers could then adjust their strategies to meet the various needs of online learners. A comprehensive online assessment system is expected to measure learning performance, teaching progress, and various factors to improve online educational quality. Therefore, the researchers propose the second question, i.e., is the online assessment system an essential construct in the online sustainable educational model?

2.3. The Use of Social Media to Sustain Online Education

Social media could facilitate online education. During this lockdown time, teachers could supervise students' learning activities and progress by using social media such as WhatsApp. They could also design lecturing videos, post curricular contents, and share learning resources through social media [27]. Online learning technologies, e.g., EdX, include some tools such as social media, mobile phones, and podcasts [28], which could be used to support online and offline education. As students share their opinions or learning resources through social media, they feel they are in the same family and can learn collaboratively. In this manner, their engagement in online learning might be enhanced. Learners could access learning resources, share information, and transfer texts, images, voices, and videos by using social media on a computer or a mobile device [29]. Social media could boost the online educational effectiveness in view of the above-mentioned

findings. The researchers, therefore, propose the third research question, i.e., are social media an essential construct in the online sustainable educational model?

2.4. Digital Literacy to Sustain Online Education

The pandemic has ruthlessly warned educators and researchers that digital literacy plays an important role in this virtual educational environment. Educators and designers must consider how to integrate digital technologies into the new virtual education environment brought about by the pandemic. Teachers and students should also increase their levels of digital literacy to keep pace with the sudden alteration from physical to virtual educational environments [30]. The use of information technologies during the pandemic and students' convenient access to technologies can be conducive to the sustainable use of educational technologies and improved digital literacy [27]. Digital literacy may be an important ability for both learners and teachers to acquire and deliver knowledge through the online educational model. The researchers thus propose the following research question: Is digital literacy an essential construct in the online sustainable educational model? Considering the new educational environment caused by the pandemic, the researchers also propose the final research question, i.e., what are the challenges in online education?

3. Research Methods

The researchers adopted a rapid evidence assessment review method because, during this lockdown period, any method that gathers people such as a questionnaire or interview is difficult in terms of obtaining approval from the academic board. The researchers adopted a four-step method to construct an online sustainable educational model in the COVID-19 pandemic environments. Firstly, the researchers obtained literature by extensively searching online databases. A researcher needs to map and assess the research themes with a view of proposing research questions [31]. The researchers, thus, secondly, identified the research themes by using clustering and mapping techniques in VOSviewer. Thirdly, the researchers selected the literature based on the inclusion and exclusion criteria. Lastly, the researchers examined the research themes of the selected literature and constructed an online sustainable educational model.

The researchers firstly obtained plentiful literature by searching online databases, then the researchers clustered the literature after removing unrelated literature and finally determined research themes based on clustering results. The researchers included various online databases such as Current Chemical Reactions and Index Chemicus to minimize publication or selection bias and to enhance the representativeness of the included studies. The researchers searched online databases and obtained 1706 results by keying in "social media" OR "digital literac*" OR "challenge*" (topic) and "education* technolog*" OR "evaluat*" OR assess* OR platform* (topic) and COVID-19 OR pandemic OR lockdown (topic) and online OR remote OR distance OR seamless (topic) and learn* OR teach* OR educat* (topic), ranging from the inception to 24 January 2022. The online databases included Science Citation Index Expanded (1900–2022), Social Sciences Citation Index (1998–2022), Arts & Humanities Citation Index (1998–2022), Conference Proceedings Citation Index-Science (1998–2022), Conference Proceedings Citation Index-Social Science & Humanities (1998–2022), Emerging Sources Citation Index (2017–2022), Current Chemical Reactions (1985–2022), and Index Chemicus (1993–2022).

The researchers output the results (N = 1706) in the form of plain texts and read them via VOSviewer. The researchers selected co-occurrence as the analysis type, all keywords as the analysis unit, and full counting as the counting method. The minimum number of occurrences of a keyword was set at eight. Of the 5192 keywords, 225 met the threshold and were classified into six clusters (Figure 1). Cluster 1 included 46 items, e.g., beliefs, blended learning, COVID-19 pandemic, design, digital divide, digital learning, digital literacy, digital technologies, distance, distance education, e-assessment, emergency remote teaching, platforms, online assessment, etc. Cluster 2 included 40 items, e.g., anxiety, burnout, guidelines, health, intervention, lockdown, self-efficacy, validity, etc. Cluster

3 included 39 items, e.g., challenges, assessment, augmented reality, distance learning, education technology, virtual learning, etc. Cluster 4 included 39 items, e.g., acceptance, adoption, attitude, behavior, information technology, perceptions, quality, etc. Cluster 5 included 31 items, e.g., achievement, active learning, collaborative, computer-based learning, engagement, performance, assessment, zoom, etc. Cluster 6 included 30 items, e.g., artificial intelligence (AI), classification, communication, community, deep learning, media, social media, Twitter, crisis, etc.

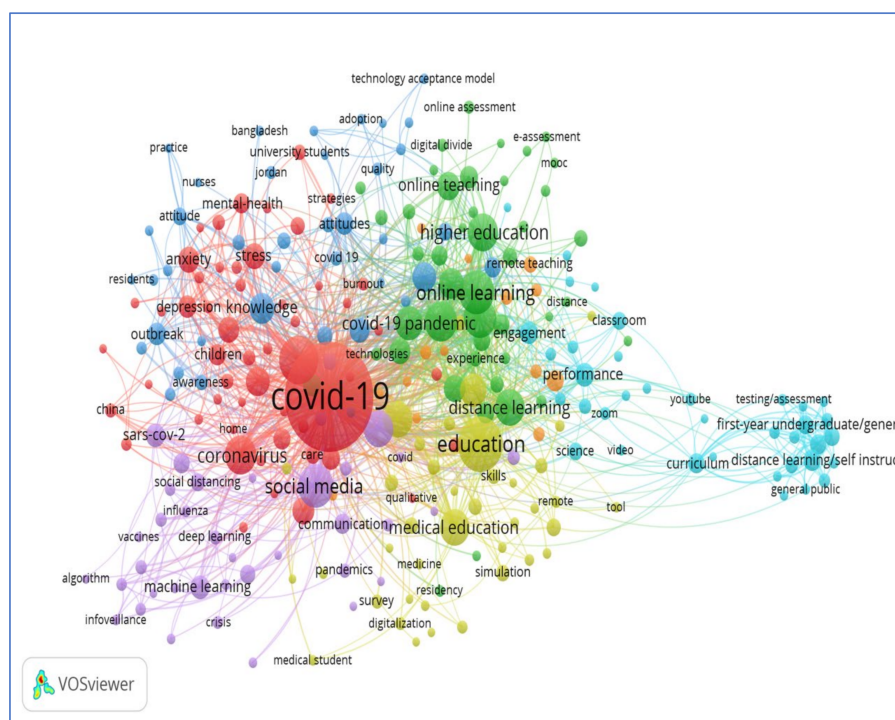


Figure 1. Clustering keywords related to the online sustainable educational model.

The researchers calculated the total strength of the co-occurrence links with other keywords. The researchers obtained a list of keywords with the top number of co-occurrence and link strength, among which the researchers found closely related keywords: platforms (N = 7, link strength = 35), online assessment (N = 11, link strength = 42), social media (N = 126, link strength = 554), digital literacy (N = 14, link strength = 36), and challenges (N = 88, link strength = 337). The online sustainable educational model will thus pivot on these keywords, coupled with challenges facing online sustainable education during the COVID-19 pandemic.

The researchers also included and excluded the obtained results based on the Preferred Reporting Items for Systematic Review and Meta-analysis Protocol (PRISMA-P) (Figure 2) [32]. Several international researchers collaborated to work out guidelines for systematic reviews, including each section of a review study such as title, abstract, introduction, literature review, methods, results, discussion, and conclusion. Two researchers reviewed the literature with high inter-rater reliability ($k = 0.92$). If both of them cannot reach an agreement on any decision, a third reviewer will be invited to determine the selection. They would include the studies if they were (1) rigidly designed and arrived at convincing conclusions, (2) could provide enough information for a review, or (3) focused on how to sustain an online educational environment during the COVID-19 pandemic. They would exclude the studies if they (1) were duplicates, (2) were irrelevant to the study based on titles and abstracts, (3) were irrelevant to the topic, (4) were out of the educational scope, (5) had no abstracts, (6) were editorial collections and non-academic reports, and (7) could not provide full-texts even after they contacted the authors. Finally, the researchers included 53 peer-reviewed articles (Please see the note above the references) for the study.

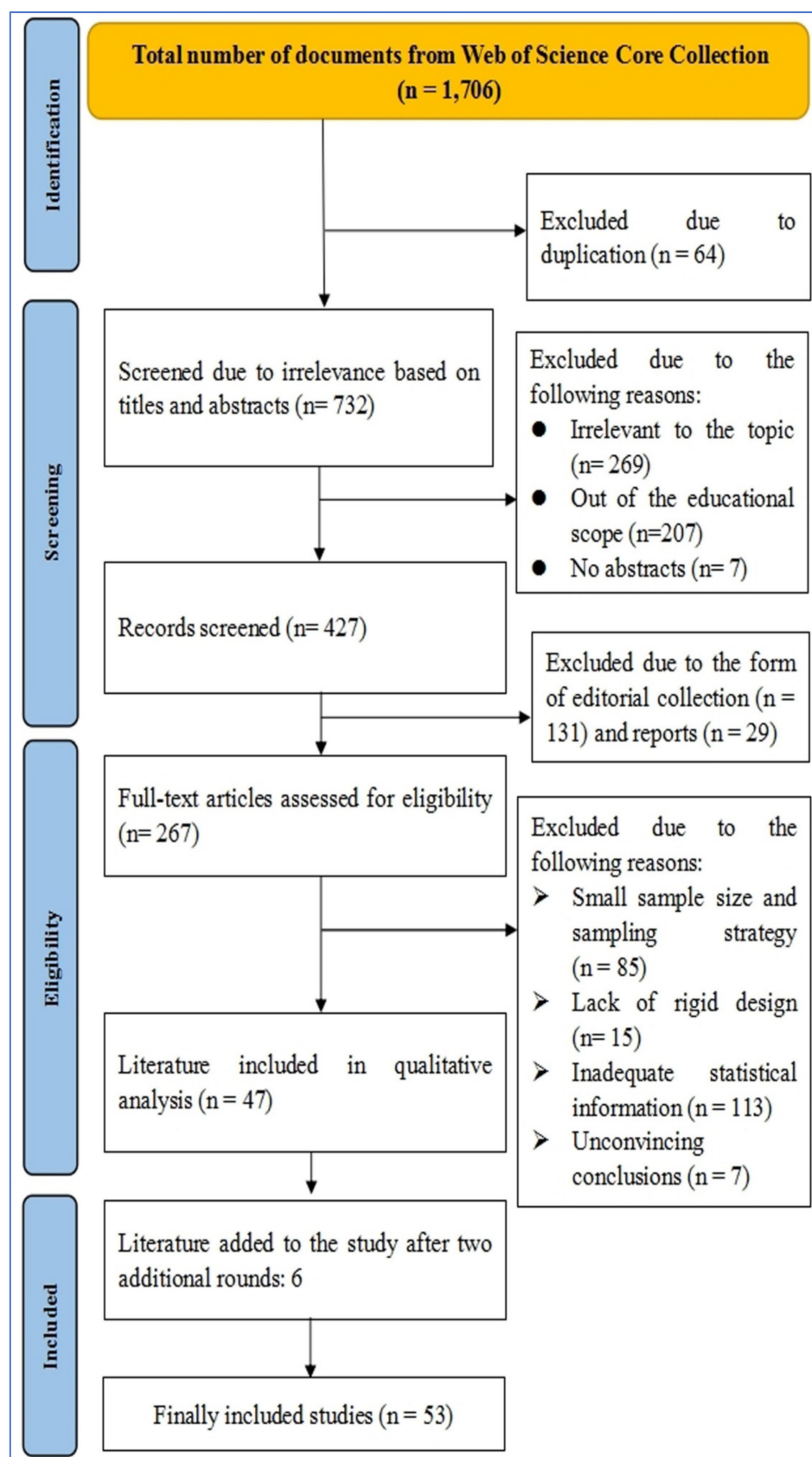


Figure 2. A flow chart of the literature inclusion based on PRISMA-P.

4. Results

4.1. Online Educational Platforms

Teaching and learning strategies must experience a radical change during and after the pandemic, which will heavily rely on online educational platforms. Online or virtual educational platforms, e.g., MS Teams, Lernraum Berlin Platform, and Webex Platform, are becoming increasingly important for students and teachers to lean on. China has made every effort to construct digital infrastructures to handle the emergency educational environment. Various online educational platforms such as Tencent Conference and MOOCs have been constructed to execute virtual learning during the pandemic since the outbreak of COVID-19 [33]. The sudden suspension of educational institutes has enforced the asynchronous learning assisted with educational digital platforms. Billions of digital classrooms have been established as a result of COVID-19 disruption. Technology-assisted learning platforms could enhance learners' creativity, motivation, and engagement [34]. A beneficial and inexpensive interactive environment can be established to improve learning effectiveness, where students and teachers could mutually interact, obtain feedback, and support each other without the need to pay dearly [34].

Scientists have developed a large number of online educational platforms to sustain online education in the pandemic environment. An online education platform, e.g., Canvas, could help teachers design video lectures, upload learning resources, share opinions, and discuss questions. This platform could establish both asynchronous and synchronous learning [4]. An online learning companion can be used to sustain the effective learning of programming among children even during the COVID-19 pandemic [35]. Educational technologies such as Małopolska Educational Cloud could facilitate online or remote education [36]. By using similar technologies, teachers and students can have more opportunities to share their documents and opinions in the virtual environment than in physical settings [12].

Online innovative technologies could sustain online education by providing benefits for online learners during the pandemic. A virtual platform could improve online interactions and allow for independent learning in virtual environments. The online communicative platforms such as Zoom and Tencent Meetings could facilitate cohort-based discussions, transfer files, and share learning resources [37]. Mobile device-assisted learning could alleviate the inconvenience caused by the pandemic. Online technologies bridge the gap between asynchronous and synchronous learning methods [38]. Online learning platforms such as Cloud Computing Services and the Virtual Cloud Learning Environment system could enhance the sense of physical presence and improve online learning outcomes [39].

4.2. Online Assessment Systems

Educators need to maintain high quality online learning and teaching by using an effective assessment system [14]. Online pedagogy and virtual assessment have replaced the traditional paper-pencil method since the outbreak of COVID-19, which is assisted with online educational platforms, e.g., Zoom, Tencent Conference, and social media [9]. Online education and virtual environments are also confronted with numerous challenges [40], where online assessment has caught researchers' attention [41]. Due to the limitations to the online assessment, such as unreliability and dishonesty, it is hard but necessary to develop reliable, valid, unbiased, and feasible online assessment tools in the online educational environment [42].

4.3. Social Media

Social media have gained popularity in education due to their ability to improve educational outcomes. Social media could be used to facilitate the rapid exchange of information and foster interpersonal relationships [43]. Social media can handle the educational environment during the pandemic by enhancing collaborative learning [44]. Social media could provide a platform for teachers and learners to conveniently communicate and collab-

orate to discuss questions, share opinions, and address issues. The constructivism theory and the computer-mediated learning theory hold that learners can break social barriers and collaborate in learning. It is, thus, necessary to build social communities to improve virtual learning during the pandemic.

4.4. Digital Literacy

Digital literacy is considered an important factor that may determine whether online education can be sustained. For instance, there are different levels of digital literacy between teachers and students in Spain. Teachers need to catch up with students in terms of digital literacy and adapt themselves to various kinds of digital pedagogical tools during the lockdown period [45]. However, teachers with a lower level of digital literacy could not skillfully adopt the online learning management system, let alone integrate it into course design and instructional methods [4]. To sustain the online educational environment during the pandemic, educational institutes should address numerous issues, e.g., technological infrastructure, teacher's digital literacy, student's computation skills, and cultural shocks [46]. Improved digital literacy could promote educational quality resources, construct digital resources, and sustain the online educational approach.

The digital literacy of students and teachers must be improved to sustain online education. A higher level of digital literacy of teachers could help them adopt digital tools and platforms to smoothly carry out teaching procedures where lecture notes could be presented to learners, assignments could be allotted to students, and voices or videos could be shown to students. Students with enough digital literacy could cooperate with teachers, download learning resources, share their opinions, discuss difficult questions, and solve technical and academic problems. Only when both teachers and students have enough digital literacy could they deliver and absorb knowledge through online platforms and social media in a collaborative manner, contributing to the sustainability of online education, especially during the COVID-19 pandemic.

4.5. Challenges of Online Education

During the pandemic, the issue of how to sustain online education has appeared as an important issue and is even a challenge in the global educational market [47]. Challenges of online education may include engagement, supervision, inadequate emergency programs, educational inequalities, technical issues, systematic learning management, and effective learning organization.

4.5.1. Engagement and Supervision

Online education may decrease learning engagement and weaken teacher supervision. The long-term lockdown has led teachers' and students' emotional stress to become another challenge in the online educational environment [16]. With virtual presence, teachers feel that it is difficult to effectively supervise students' attendance and attention. Students could easily escape from online lecturing by turning off the cameras. Those with weak self-regulation would surely obtain poor academic achievements. During the pandemic, senior students tend to possess stronger self-regulation and autonomy than the junior ones in online learning environments. Different educational institutes adopt different teaching strategies without unanimous plans for emergency teaching in Spain. Teachers tend to fail to self-regulate their teaching activities due to their familial issues [48].

4.5.2. Inadequate Emergency Programs

Although emergency programs have been established in many countries and areas, many of them feel that it is hard to successfully cope with the lockdown environment. China is the first country to handle the pandemic by combining online with offline education [49]. The shortage of complete emergency plans in education on a large scale frequently cornered educational institutes in online environments. It is also hard to predict how to survive the potential development and what harm the pandemic will bring about and how to make

perfect plans to sustain the online educational environments. Digital infrastructures may be unable to meet the vast requirements of sudden online education. The pandemic forced teachers to conduct both online and offline pedagogy, challenging the virtual or physical support of educational institutes such as digital infrastructure [50].

4.5.3. Educational Inequalities

Online or virtual learning environments have foregrounded educational inequalities. Different family economic statuses could make inequalities exert an important influence on online learning during the pandemic. Policymakers, educators, and technicians could assume responsibility to address the negative impact of COVID-19 on educational inequality [51]. Technological stress, pandemic resilience, and fear of the pandemic could negatively influence learners' coping strategies and cognitive abilities in online environments. To sustain online education, designers and teachers could manage to reduce learners' fear and stress, stimulate resilience, and improve educational equality by enhancing their online learning self-esteem and academic achievements [52].

4.5.4. Technical Issues

Technical issues are posing as another challenge facing students and teachers. Insufficient access to the Internet and online platforms might offset online learning effectiveness. Teachers or students might feel resistant against new virtual platform-based learning where the individual's Internet connection plays an important role in maintaining normal online learning and teaching process. The slow or freezing connection speed might negatively influence online learning effectiveness [22]. Furthermore, teachers and students may feel that it is hard to handle some applications or platforms, which will negatively influence information distribution between learners and teachers. The compatibility of different software and hardware may cause system failure and stagnate learning and teaching procedures.

4.5.5. Learning Management Organization

Despite the increasing number of online educational platforms, traditional online education could not meet diversified demands due to the shortage of systematic learning management and effective learning organization. The complete rate of an online course remains low and online learning outcomes are not satisfactory [53]. Parents and teachers of primary and secondary students feel that it is hard to accept the online learning outcomes due to their weak self-regulation and low learning efficiency [54]. In addition, it is difficult to design a perfect online assessment system due to many issues, e.g., online risks, Internet connection, technical difficulties, data unreliability, information leakage, and changeable skills [55]. Tracking online learning and teaching progress may be not an easy issue to address.

4.6. The Online Sustainable Educational Model

Considering the above findings, the researchers constructed an online sustainable educational model. As shown in Figure 3, the online sustainable educational model is made of online platforms, online assessment systems, social media, and digital literacy. Educational institutes should establish digital solid infrastructures and construct stable online platforms to sustain online education. Meanwhile, online assessment systems must accompany online educational platforms to collect learning and teaching data. In this manner, teachers can master the learning progress and adjust teaching progress and contents in a timely manner. Social media should also be integrated into online education to improve learner–teacher interactions and maintain interpersonal relationships.

The online sustainable educational model also includes challenges of online education. They include lower engagement and weak supervision, inadequate emergency programs, educational inequalities due to uneven distribution of digital resources, technical issues, systematic learning management, and effective learning organization. Technical issues seem

unavoidable in online environments. Students and teachers frequently meet difficulties they fail to solve. Their digital literacy is, therefore, essential in terms of the independent solution of technical issues. It is noteworthy that systematic learning management and effective learning organization require advanced and complicated development of learning management platforms, which may be unaffordable in some areas and countries. Online educational inequality may be caused due to different levels of affordability. Challenges and features in online learning may be mutually correlated and the online sustainable educational model cannot survive without the presence of either of them.

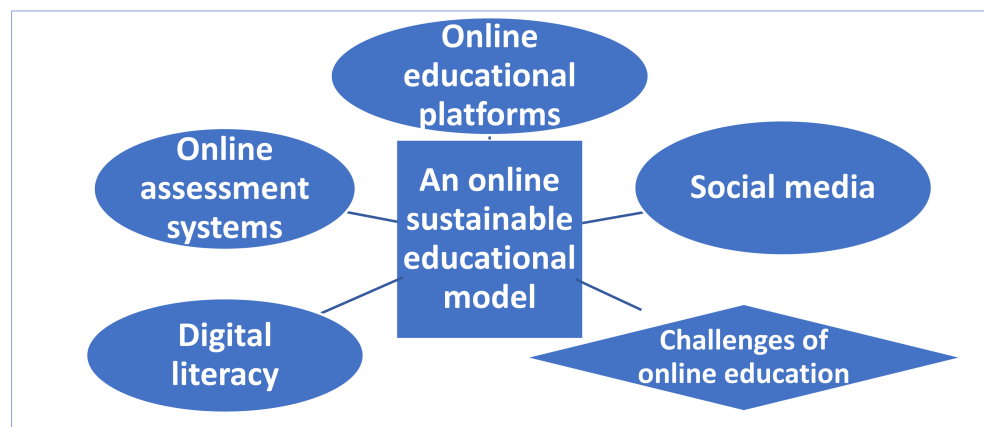


Figure 3. The online sustainable educational model.

5. Discussion

5.1. How to Unite Various Online Educational Platforms?

Since the eruption of COVID-19, the number of online educational platforms has boomed. The dramatic variety of platforms has confused teachers and students since it is difficult for them to skillfully use all of the platforms. Establishing several uniform and easy platforms is difficult to realize since it is concerned with complicated aspects such as economy, culture, politics, and even security. Uniform online platforms, which are beneficial to environmental protection, could make them easy to use and convenient to share. It is possible to achieve this goal at an international level. Some international organizations could assume this responsibility by formulating commonly accepted guidelines for online educational platforms. Developers and designers can then produce online educational platforms following the internationalized guidelines.

A commonly acknowledged online education model should be characterized by its ease of use and usefulness. In other words, a widely accepted educational online platform should be easy to use and useful to learners. Only when the platform is easy to follow can learners adopt it to learn and interact with peers and teachers. If the platform is difficult to use, learners may turn to other platforms that are easier to use. The contents on the platform should be beneficial to learners so that they would feel they could learn something from the platform and determine to continue its use. International online educational platforms could be developed based on other commonly beneficial factors in order to be globally united.

5.2. How to Design Online Assessment Systems?

Educational management needs to design a system to assess online educational outcomes to complement the weakness and disadvantages of online remote education. An online examination system should also be designed to assess online learning achievements [30]. The online assessment could be conducted in both asynchronous and synchronous forms, establishing the foundation of an online assessment. For instance, Moodle is a beneficial tool that can facilitate the online assessment [56]. The feedback from learners and teachers is considered an important reference for the improvement of online edu-

cational quality [57]. A learning management system could provide references for the learning progress and a choice of solutions by automatically collecting data [45].

Online assessment systems are a very important part of the online educational process. However, due to the differences between online education and traditional education in learning environments and methods, the assessment model in the traditional education model is not suitable for online education. Therefore, during the pandemic, with the rapid development of online education with computer and information technologies, it is very important to build a set of online education behavior analysis and assessment systems for learning and teaching practices. The assessment model of online education analysis mainly analyzes and evaluates students' online education behavior. This assessment model may include student learning behaviors, guidelines for learning, enhancement of learning effectiveness, collaborative learning assessment, assignment assessment, and assessment of learning resources.

5.3. What Are the Benefits and Ways to Use Social Media in Online Education?

Social media may bring benefits to online education, and in many cases, they promote remote or hybrid educational environments. The popularity of social media used in education continues to grow since social media can benefit online education in many aspects. The use of social media could facilitate collaborative learning [58]; provide various learning opportunities of multiple cultures [59]; improve digital literacy and critical thinking [60]; enhance learning motivation [61]; increase formal and informal engagement in learning [62]; develop academic careers, personal identities, and social connections [60]; train attention and self-organization abilities [63]; and finally improve online educational outcomes.

Social media act as a medium to connect the links between online and offline education. Students could conveniently interact with peers and teachers by using social media. Social media can, therefore, be a platform for interactions before and after class. The popular flipped pedagogical approach can also integrate social media into the educational process. Teachers could allot assignments to students, post notices, and check their learning progress through social media before class. After class, students could resort to communicating with teachers or peers by using social media in cases where they meet difficult problems. In the blended educational model, social media can realize seamless learning and promote opinion sharing and problem solutions. Teachers can establish a discussion group where students can raise questions and teachers can provide feedback either asynchronously or synchronously. Educational institutes could make every effort to establish multiple social learning communities to enhance collaborative learning by improving their mutual interactions through social media. Learners could also maintain social relationships via social media during the pandemic. Collaborative relationships are necessary to sustain virtual or online learning approaches [64].

However, there are some negative effects of the use of social media on online education. Students may post or download various kinds of contents that are not related to learning for common sharing. These contents might act as distractions of learning activities. There is, thus, much room to normalize the content shared on social media [28]. Teachers could guide students to view more learning content than entertainment. Designers could also introduce more learning content and reduce non-academic advertisements. Featuring the function of interactions, social media might also distract learners due to frequent interpersonal interactions. Teachers could thus encourage students to foster learning environments during peer interactions.

5.4. How to Improve Digital Literacy?

To improve digital literacy, researchers can enrich digital education by using 5G-based high-definition videos, virtual reality, and AI. The researchers can also use digital technologies to improve e-learning, mobile education, shared learning experience, and digital resources. The use of digital tools jointly with life could create a good digital learning atmosphere and make convenient digital services available to learners. An integrative

educational platform could immerse learners in digital environments, popularize AI and digital applications, promote collaborative educational programs, and facilitate the in-depth implementation of digitalized educational tools. AI is becoming an increasingly important technology that cannot be ignored in the improvement of digital literacy. Teachers and designers could integrate AI into aspects of education with a view to enhancing digital literacy.

5.5. How to Address the Challenges in Online Education?

The methods for addressing the challenges of online education may be varied due to various kinds of challenges. Online educational platform developers can design online applications to enhance supervision over learning behaviors. Serious games could be integrated into online educational platforms to increase learning engagement [65]. Applications could be designed to record students' learning behaviors and provide reminders when students behave improperly. Policymakers of online education should assume the responsibility for formulating adequate emergency teaching and learning programs or criteria to normalize online education. The technological infrastructures of educational institutes are an important support to sustain the virtual educational environments. Sustainable technical support and administration could help teachers and students handle the remote emergency education in the complicated pandemic environments [66]. Digital infrastructures could be improved to promote educational qualities and solve technical issues. The administration could also establish specialized departments of systematic learning management and organization to supervise online education.

6. Conclusions

6.1. Major Findings

This study aims to find methods to sustain the current online education during the COVID-19 pandemic by establishing an online sustainable educational model. The model consists of online educational platforms, online assessment systems, social media, and digital literacy. Challenges should also be addressed to sustain online education during the pandemic.

6.2. Limitations

There are several limitations to the current study. In the first place, the study failed to include all related documents due to limited library sources. In the second place, the sustainable model may vary according to the development of the COVID-19 pandemic. In the third place, more features may not be included in the sustainable model, which needs further exploration.

6.3. Implications for Future Research

Future researchers could equip online learning tools with some necessary features, e.g., whiteboard, lecture recording, attendance supervision, notification of assignment, quizzes, tests, and schedules [67]. Teachers could dynamically write important information on the whiteboard to attract students' attention and increase their learning engagement. Teachers could also increase students' completion rates and decrease their drop rates by playing recordings, supervising their learning progress, reminding them of assignments, tests, and quizzes. Teachers could also inform students of rigid schedules and request them to learn based on the timeline. Those who fail to learn according to the timeline should be warned or even punished.

With advances in information technology, the sustainable online educational model may be updated and perfected via the addition of more practical features. For instance, virtual reality, as a useful technology, may play an important role in sustaining online educational effectiveness [68]. The use of advanced evaluative and instructional tools might improve and sustain online education [69]. Future research could also attach importance to online questionnaires since they could improve online educational outcomes and they were

easily implemented in online educational platforms. Future research could also extend the online sustainable educational model by including more features by using interdisciplinary research methods.

Future research should attach importance to AI since it plays an important role in improving online educational outcomes. Researchers could combine intelligent tutoring systems with online learning with a focus on learners. AI could cater online learning styles and contents to individualized needs, facilitating collaborative online learning. Profiling, predicting, and personalized adaptive systems will feature AI-assisted online education in the future [37]. Designers and teachers could keep pace with AI development and make every effort to promote online educational outcomes by integrating AI technologies into aspects of online education. Educational institutes should cultivate students' and teachers' digital literacy, as well as the mastery of AI knowledge.

In the future, researchers should examine how to establish learning social networks to address the lack of big data for learning. Developers should study machine learning algorithms based on educational big data. They should carry out large-scale curriculum knowledge mapping research to remove barriers to all online courses and establish the association between courses, online databases, and digital libraries. They should develop intelligent auxiliary teaching technologies for various courses, establish a technical support environment for cross-disciplinary education, and design intelligent teaching assistants to facilitate online teaching. They should promote the use of virtual reality, augmented reality, and virtual laboratories for educational purposes. Developers, designers, and teachers should also investigate the ethics of the use of AI in education.

In the future, it may be hard to establish an online educational model to address all challenges in an online educational system. Addressing challenges may be an urgent issue to sustain an online educational model. In addition, there may be other challenges excluded from this model. For instance, online assessment is a great challenge for an online educational model [70]. Online assessment may involve formative and summative methods. Both methods may be unreliable due to different systematic conditions, online cheating, and difficulty in invigilation. A lack of emotional exchanges may cause misunderstandings among learners and teachers. Future research could take measures to address various challenges.

Another direction of future research in the sustainable educational model may be to develop the creativity of teachers and students, including knowledge checking, which is a particularly sensitive element of online education [70]. Strong creativity could also help students and teachers in innovating new approaches to solve difficult problems and to address various unexpected issues in online education in the future.

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References

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