

COMPUTER SUPPORTED COLLABORATIVE LEARNING (CSCL) AS A VIRTUAL LEARNING ENVIRONMENT ON MATHEMATICS

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ABSTRACT

The Covid-19 pandemic has ravaged the world for more than a year, far beyond what experts predict. The impact of the Covid-19 pandemic for Indonesia is to accelerate the implementation of the 4.0 education revolution. Computers and the internet have an important role in the learning process during the Covid-19 pandemic. This research is a literature study that reviews previous research using the systematic literature review (SLR) method. The purpose of this study is to seek information, examine basic theories and examine the results of previous studies related to CSCL and VLE. Data collection is done through the process of editing, organizing, finding documents, manuscripts, photos and videos. To obtain correct and precise results in analyzing the data, the author uses content analysis techniques. Data analysis was carried out through descriptive and thematic analysis. The results of this study indicate that VLE-based CSCL has been carried out successfully and is very useful in distance learning, especially during the current covid-19 pandemic. Based on these results, it is recommended to develop a VLE-based CSCL to see its impact on mathematics learning in schools, especially the impact on problem solving skills.

Keywords: CSCL, virtual, learning, environment, mathematics

1. Introduction

One of the effects of the 2019 Coronavirus pandemic is on education worldwide, leading to widespread closures schools, madrasas, universities, and Islamic boarding schools. UNESCO (United Nations Educational, Scientific and Cultural Organization) on March 4, 2020 recommended the use of distance learning and opening up educational platforms that schools and teachers can use to reach learners remotely and limit educational distractions (UNESCO, 2020). In connection with these developments, the Ministry of Education and Culture (Kemendikbud) also took policies as a guide in dealing with the disease at the education unit level (Kemendikbud, 2020). Globally, UNESCO's monitoring results stated that as of April 13, 191 countries had implemented national closures which affected 1,575,270,054 students (91.3% of the student population) (UNESCO, 2020).

The effect on the existing concepts, processes and designs has undoubtedly changed in COVID-19 age. The Covid-19 age has impacted conventional learning, one of which is that teachers and students have to get adjusted to online learning. The Covid 19 age often urged

teachers to apply the learning pattern of the student centre. Face to face between teachers and pupils require the development of learning patterns with a sense of inventiveness and invention.

The digitization of nearly all elements of life during the last quarter-century – what Negroponte refers to as the “change of atoms into bits and pixels” (Negroponte, 1996) – has had an impact on us all. However, because it is the only world they know, the digital world is even more present and pervasive for those born after 1980 than it is for the rest of us. They are the 'digital ones,' also known as the 'N-Gen – Net Generation' (Tapscott, 1998). The majority of them are still youngsters or teenagers who have spent their entire lives in a changing but (from their perspective) primarily digital world. Significantly, the majority of students in higher education now fall into this category.

Technology allows us to create learning environments that actively engage and guide learners while also allowing them to pick their learning style and arrange their knowledge objectives. This learning environment conception enables learners to shift from studying in a

physical area, such as a lab or lecture theatre, to learning in a student-centered learning environment in cyberspace. This, in turn, leads to personalized learning, adaptive learning, and learning through entertainment (Andone, et al., 2005)

VLEs are specialized information systems that enable the creation and application of various learning scenarios and approaches (Kurilovas, E., & Dagiene, V.). Many new tools and products have been developed since the Internet's inception in the early 1990s in order to fully leverage its benefits. Virtual Learning Environments (VLE) have emerged since the mid-1990s with the goal of enabling learning and teaching activities through the Internet.

For students and teachers, the Internet provides benefits such as flexible access and new ways of interacting and assessing. The Internet also has significant drawbacks, such as reliance on information service providers, malware, and slow connection speeds. Creating Internet tools that are interesting, appealing, easy to use, and educationally sound, on the other hand, takes time for the teacher. Teachers can use VLE to generate resources rapidly and without having to learn technological skills. VLE provide an integrated set of Internet capabilities, allow for easy material uploading, and provide a consistent appearance and feel that may be adjusted by the user.

Our society is evolving. A new educational paradigm is emerging, one that incorporates computer and Internet technologies into schooling. Books aren't the only way we learn. We have a plethora of technological tools at our disposal. The use of technology, particularly the Internet, brings up a new world of possibilities. Education may go beyond the physical confines of the classroom with the use of technology, giving students the opportunity to experience more.

The Internet's ability to facilitate global cooperation and international teaching and learning is one of its most significant benefits to instructors. Students from various regions of the world study together by using online resources, reading each other's ideas and points of view, discussing common concerns, and comprehending the contrasts in their attitudes. Digital technology pervades almost every aspect of students' and teachers' lives: school systems typically have at least one computer for every 15 students, teachers participate in on-line computer conferences with colleagues, schools are clamoring to be linked globally with the Internet, and video games and

home computers are becoming more commonplace in students' lives.

A sizable proportion of instructors remain hesitant and distrustful about the Internet, with Becker (2000) claiming that up to 70% of American teachers are reluctant or late adopters of new technology. Only around a quarter of all teachers have included technology-based tools into their normal classroom programming. According to the same Becker survey, only 20% of teachers have advanced skills in integrating technology into the classroom.

While computers are useful in education, they cannot replace the natural world. Although computer technology allows us to view an example of how a stream's ecosystem operates, in order to gain a complete and true knowledge, students must visit a stream and conduct their own observations and testing. The fictitious cyberrealistic depicts only a skewed image of natural existence.

The use of the Internet in education has gained a great deal of attention. When compared to traditional in-class education, there are several clear benefits. The benefits influence children and teachers in many ways. Students are those who have registered in a learning course. The individual in charge of teaching the class is known as the teacher/instructor. The teacher will distribute materials, e-mails, and so on, informing students of what they need to do.

There are several advantages to using the Internet. One big advantage of using a virtual classroom is that it can aid in instructor organization. Course materials, assignments, class notes, and other information can be easily classified in separate areas. The establishment of a "virtual notepad" can help both the instructor and the student find documents more easily. Having this information available on the Internet allows professors to easily update and revise course content.

In 2001, a case study was conducted to investigate the utilization of virtual classrooms. According to Jason (2001), pupils see the utilization of the virtual classroom as a convenience. It is much easier to find information on the Internet because it is available 24 hours a day, seven days a week. Distance learning courses can be completed at any time and from any location. Students can access this information without contacting the instructor.

The virtual classroom also helped students acquire a variety of communication and social

skills, allowing them to overcome their relative isolation by engaging with others in similar situations. Cost is also regarded as a benefit. Students save money by not having to commute to class, which saves them time, petrol, childcare, and travel expenses. Another advantage of the virtual classroom is that it saves time. Students who are motivated and/or rapid learners may be allowed to advance more quickly than in a typical in-class situation. Because most interaction with instructors will be done by email, messages can be delivered at any time of day or night, communication is seen as a plus.

To the teacher, the fact that everything is digital is a benefit. Because all work is provided by e-mail, instructions can easily deal with student work. Because everything is typed, the teacher is no longer required to decipher handwriting. Another benefit that teachers have discovered is reusability. Teachers can repurpose their own materials and readily obtain content from others.

Many teachers who have tried online classrooms, according to Robert Tinker, have been overwhelmed by the enrollment of ten to twelve students. Each student needed to have their own email address, which was ultimately the professor's responsibility. "It's like having infinite office hours," one teacher said. Because students demand a rapid response or feedback when they submit email, teachers must be available 24 hours a day, seven days a week.

It might be difficult or complicated to adapt non-online education to online courses. Although many classes have done well with the online course, there are some that haven't. A lab section of a science lesson is an example. Lab classes necessitate a significant amount of hands-on effort. Online courses cannot provide the hands-on experience that a classroom lab provides. This is not to argue that the computer cannot perform some of the lab exercises. However, the Internet cannot replace the hands-on approach that students receive in a classroom lab. Brey (1991).

Students can get to know one other over the net but the link made by face-to-face interactions does not replace it. Clear instructions are also a mistake in learning on the Internet. Often these problems are easier to handle in person than over the Internet. Another concern with Internet-based learning is procrastination, because people are not required to stay to a predetermined timetable. A routine is therefore often not created and the work is not finished in time.

Distance learning creates new challenges for teachers. In some circumstances it might be as simple to achieve student success as limiting student withdrawals from online learning. Distance learning offers teachers the option to teach both subject and lifetime learning to their pupils.

The function of teachers is changed to that of educators by technological advances. New technologies such as telephony, multimedia, IT and virtual reality are a consequence. Teachers who follow structured lesson plans are vanishing in significance because students are no longer enthusiastic about lectures or books. Videoconferencing enables the students to study from "visiting" scientists, business professionals, writers, mathematicians, etc. Rural teachers get access to experts in their industry, and students have access to lessons that are currently not available in local schools.

Technology is now an essential aspect of the world in which we live. Every day it plays a bigger role. When technology is introduced into the classroom, the way teachers learn and students learn can produce astonishing transformations. The educator and the student are both energized, enthusiastic and fascinated by new ideas and barriers. Knowledge is not just grasped, but applied to seek more instantaneously and creativity rises.

Technology will undoubtedly supplant education that only transmits facts. When it comes to presenting facts in an extremely impactful, fun, full and correct way, multimedia presentation is difficult to surpass, particularly those that use advanced "gaming" tactics. And these are getting more and more available on the Internet. It is even possible for certain ideas, in particular when expressed as basic rules, to be taught utilizing multimedia.

Unbiased Internet access would result in the loss of information for teachers and schools for life. Teachers must be prepared for students who are themselves learning new research resources. Since information is not knowledge and the internet material needs to be screened carefully, school curriculum have to change in order to give pupils the ability to sort, filter and synthesize. Teachers should accept the premise that their classrooms are designed, guided, coached and discussed, not information transmitted.

Recent learning studies show that technology can play a crucial role to promote more engaged and effective learning in changing

educational environments and restructure schools. Some evidence shows that technology can even expedite the reorganization process, in particular when it concentrates on utilising learning materials outside the classroom (Pisapla, Schlessinger, & Parks, 1993; Jones, Valdez, Nowakowski, & Rasmussen, 1994).

The Internet is therefore a vital instrument both for the reorganization of schools and for fostering committed study. The Internet allows educators the opportunity to integrate technology into their lessons and provides teachers with access to various resources outside of their classrooms. Teachers can encourage kids to learn when they are preparing for work outside school through the Internet.

Harasim (1990) explains out why online teaching promotes active learning. Firstly, collaborative effort and study quickly active information and knowledge search and sharing. Secondly, fair involvement assures that every student is highly important for group work, and active knowledge contributions aid each member's success. Third, the asynchronous method of on-line engagement allows students to enter information from an unidentified location and at their convenience. According to a research by Montgomerie and Harapnuik (1997), schistic students were more interactive than in the person mode. They discovered that in conversations students were more open and reflected their opinions in depth during online lessons. Finally, the text-based aspect of the Internet produces active learning. While the Internet permits film clips, music and visuals to be loaded, text is used mainly (through e-mail, gopher, ftp and veronica). Reading encourages students to systematically create the meaning of the material they are about to share and communicate, therefore fostering active learning.

Searcy (1993) studied whether they are learning both via distance education and through regular education. Studies have been carried out. The average GPA across telecommunications and traditional formats was no significant. However, Searcy found that in the conventional sections the graduation rates could be greater than in the television sections. This conclusion raises more issues about the things which could hinder the completion of your course.

The popularity of Internet-based distance learning is expanding incredibly fast. Professionals are far more attractive to distance learning than traditional learning methods.

Distance learning makes sitting in a classroom far less desirable due to the flexibility and convenience provided. A post-secondary education study department identified 58% of public colleges for 2 years and 62% of public schools for four years providing distance learning. Another 28% of public institutions in two and 23% in four years aim to start offering distant learning in three years.

People who are looking for education should be aware that anybody who enters the teaching profession, particularly new teachers, may need distant learning. Teachers with these qualifications are more marketable now than teachers with these qualifications. Learning the technology is often the biggest challenge for teachers. It is normally the duty of gathering together your technology knowledge and applying it to instruct pupils through the internet. It is one thing to learn, but it is something else to do well.

One approach online chat lines is to actively connect students and professors. But most internet-based learning programs do not employ chat sessions, since all participants must be online simultaneously. One of the keys to success in distant learning is to be technologically comfortable. Many schools require instructors to be trained on computers, yet some teachers are left alone.

Despite the limitations involved with this programme, many universities and community colleges perceive the possibility of on-line distant learning. Some schools see this as a chance to expand their diversity of students and increase inscriptions. Community colleges are frequently confined to students inside or within 50 mile radius of their local area. Distant learning helps these universities to extend the programs they want. More professional students return to school, and demands are changing. The desire has always been there, but the internet learning opportunity did not exist. This style of learning is promoted by technological development and the popularity of the World Wide Web. The web communication is the standard today and it is in the minority of people who do not use it. Institutes like companies have to change and adapt to the changes that take place in the community. You know that the lack of will to modify can and will lead to missed opportunities.

The Internet is a very unique and powerful technology that has an enormous impact on all educational and learning activities in the classroom. The Internet not only enables

worldwide teaching and learning, it also adds opportunities to teaching and learning from afar in the world by adding options for various sorts of communication with partners. Communication via Internet tools such as e-mail, IRC, and WWW (HTML) and information searches.

In school reform, the Internet can play a crucial role. Reform attempts focus on genuine assignments that make students more responsible for their own learning. Teachers must adapt in order to prepare productive citizens for a changing technology society. For the future century, traditional educational approaches are no longer applicable. New times require new learning methods (Jones & Valdez, 1995).

Multimedia enables pupils to learn best, whether it is by reading, viewing or actively involved materials. Committed students are those who are accountable for learning, and they are stimulated by learning because they are responsible. Teachers who answered the survey agreed that the use of technology in the curriculum can support committed learning.

The Internet equips kids with immediate and global awareness. Students and teachers can interact in various parts not just of the country, but worldwide. They can learn from this about life and problems that affect other individuals. Many teachers can access relevant Internet discussions. Educators can take advantage of these debates and the possibility to exchange experience in professional development with other educators and to fight the perceived isolation.

High schools will in future no longer select between audio or visual, interactive or independent systems, or single or two-way systems. By connecting the school, library, workplace and house, a single wire will provide everything. It will be a challenge to find the most practical blend of learning experiences based on the compromise between the costs and the capacity of a wide range of media possibilities. The focus of educational organizations in this setting will move from education to learning. Adapting to this transformation will necessitate new approaches by educational organizations to define faculty job and to secure funding for new technologies. Distance training is essential for the dissolution of learning limits despite the changes and lasting uncertainty.

Internet's eruption into popular culture that has begun to exploit many professors and institutions to increase their teachers' teaching capacity through the sophisticated network

infrastructure. More and more students start to browse their materials on the web and communicate with the students via e-mail. In certain institutions, lecture software is utilized to build online panels between students. These modest advances are merely the first and it is no surprise that software developers and research organizations within colleges have recently shown interest in investigating ways of moving forward. (Britain & Liber, 1999)

2. Research Methods

This study is a literature review that employs the systematic literature review (SLR) method to review previous research. Systematic reviews will be quite helpful in synthesizing diverse pertinent research findings. In theory, a systematic review is a research approach that summarizes the findings of primary research in order to give more full and balanced information. Meanwhile, meta-analysis is one method for statistically synthesizing results (quantitative technique).

SLR research begins with the development of a systematic review research methodology, followed by the conduct of systematic review research. There are quantitative and qualitative methodologies in the systematic review. The quantitative method of systematic review is used to quantitatively synthesize research results. A qualitative SLR technique was adopted in this investigation.

The goal of this study is to find, assess, evaluate, and interpret all research on VLE based CSCL. The SLR approach allows for a systematic evaluation and identification of journals, with each process according to the processes or protocols that have been established. String search, title and abstract screening, filtering and assessment, and data extraction are all used to collect data. The descriptive and thematic analyses were used to analyze the data. As previously said, the data gathering of study outcomes utilizing a systematic review approach is accomplished by browsing the internet (PubMed, MEDLINE, Elsevier, national journals, and others).

3. Results and Discussion

What is a Virtual Learning Environment (VLE)?

An integrating system builds on established networking technologies to be used as teaching and learning instruments individually. These include software for conference, e-mail, online

resources, multi-media and search engines, video conferencing, shared whiteboards, and interactive simulations. These systems are known collectively as online learning environments, learning management systems, collaborative learning software, etc (VLEs). (Britain & Liber, 1999).

Users of a VLE are often classified into two primary classes: students and teachers. While teachers have a similar system vision for students, they will typically have additional instruments and powers to add curriculum, organize conferences and track progress of pupils. Students have a dialogue area that is private from the teacher's perspective in some circumstances.

Noticeboard

A noticeboard zone may be a valuable feature when a student logs into the system.

Course outline

The overview of the structure and dates of tasks, evaluations, presentations, video conference etc. might be included in the course outline. The system will often give the teacher with a systematic way of creating the curriculum. The course description offers hyperlinks to the course pages. In the web system, the materials for that part of the course are just html-pages.

E-mail

Most systems offer an integrated email that can be used to email the teacher or pupils.

Conference

The core for many VLEs is the asynchronous conferences or discussion groups which allow students to exchange ideas and topics collaboratively.

Class List & Students Homepages

A further important characteristic of a learning environment is to meet other students at a course or to provide teachers an understanding of their histories, interests and objectives. Many systems have a list of students registered for a course, possibly with e-mail addresses. The inclusion of a website for each student is much more valuable. Some systems include a front interface for homepage editing that is straightforward to use.

Metadata

Metadata is just object information. In particular, it is crucial that things are categorized and searched according to their intended function.

There are a range of information on a particular object in a sophisticated metadata set. For instance, the metadata might offer information on who made it, when generated, who is the target audience etc. for a Java applet that is included as a resource in a course unit. Most of the current VLEs provide a simple scheme for supplying metadata about resources, courses and persons, but the metadata issue is being given greater attention by some currently developing systems.

Assignments

An VLE should enable teachers to establish jobs for students to accomplish throughout their studies. It should enable students with a way to provide their graduation and feedback to the teacher.

Assessment

Some VLEs provide automated on-line evaluation tests, and some systems are equipped with self-test versions.

Synchronous Collaboration Tools

Some, although by no means most VLE's, include synchronous collaboration capabilities such as chat, Shared whiteboards, Group browsing and video conferencing. The relative relevance of these instruments in a system primarily depends on the intended application of the system.

Multimedia resources

An important benefit of VLEs is the ability to access multi-media resources and store them as an integral part of the course package within the learning environment. The value of multimedia services will expand rapidly when increasingly complex educational materials like interactive simulations are offered on-line.

File Upload Area

For genuinely interactive functioning pupils should be able to download their own documents for other participants, rather than only get contents provided by a teacher into the systems. In certain VLEs, students can build their own materials and objects in the learning environment.

Calendar

A tool for calendars is a handy function incorporated in certain VLEs.

Search Tools

If there are multiple participants who surf about the surroundings and hyperlinks alone might get

pretty loud if a course structure is extremely large. Consequently, some systems provide search features to skip directly to topics of interest or to a particular individual. See the Navigation Model section, too. Search tools are very beneficial when the VLE consists of a broad resource base of items.

Bookmarking

Like search tools, the time spent navigating to common places or items in the environment can be considerably reduced by bookmarking. Some systems provide a more advanced bookmarking version, enabling players to create their own resource base.

Navigation Model

Although navigation does not consist exclusively of a VLE feature or tool, it is organically part of the VLE experience. The navigation facility enables a user to move about the environment and in conjunction with the appearance and feel of the system, the browsing model or metaphor is incredibly significant as it dictates how the system is utilized in many ways. Besides using hyperlinks, the tools provided and the course structure will be displayed using different VLEs, which are usual for the experience of using a conventional web browser.

Currently available VLE

The currently accessible VLE systems come from one of the two primary historical sources and are necessary to understand the difference. The main source of commercial systems on the market is the distance learning industry online in the U.S. The initial source. Popular VLEs like TopClass, LearningSpace and the Web Circulation in a box are examples of systems that have been developed in this context. However, distance learning is only a fraction of the current interest in VLE, since institutions are looking for ways of using technology to make education more effective. It is not obvious that distance learning systems are best designed for this purpose.

CSCL as VLE

The objective of this survey was to determine which VLE software (if any) are being used and to gain opinions on their ease of use in accomplishing certain activities. We also wanted to know how many respondents reported using a

teaching and learning online system (e.g. putting lecture notes on the world wide web).

In the survey tool we first asked respondents to describe any teaching and learning systems. Details on the use of virtual learning environments, conference systems, worldwide web and synchronous communication systems were particularly requested. The second portion of the tool asks respondents about system efficiency in a number of tasks. These were grouped according to the tasks a VLE should be involved in.

The survey results were the following: On the cut-off date 11 of the 100 survey forms submitted have been returned. Out of the 11 replies: all 11 claimed that they were using the WWW to teach and study in some way. Nine interviewees mentioned using a virtual education. The system of first class conferences was used to report to five respondents. Six of them reported using synchronous systems. Three interviewees reported with virtual labs or simulations.

Analysis and findings from such results: 1) Informal evidence from a series of institutions indicates that few attempt to adopt a coordinated approach for the overall institution, with entrepreneurial departments and enthusiastic individual lecturers implementing numerous diverse ideas. This situation presents fascinating considerations about the usage of VLEs in institutions to support existing training. A single heavyweight system may not be a good model for institutions, because different departments and professors have distinct requirements to satisfy the needs of all departmental services. 2) Many institutions are still immature in using virtual learning environments and other online learning methodologies. This can be predicted to change quickly if educators remain highly concerned with VLE and alternative teaching / learning practices and if new and enhanced systems continue to emerge highly.

The CSCL's objective is therefore to help students effectively study together. CSCL allows learners to be able to communicate ideas and information, collaborative access to information and documentation and peer feedback (Hurme & Järvelä 2001). The CSCL also supports and encourages group processes and group dynamics that cannot be achieved through face-to-face communication, such as having students identify their communication aspects (Stahl, Koschmann,

& Suthers, 2006). However, CSCL environments generally failed to meet expectations as academics and practitioners did not help groups to succeed (Kreijns et al., 2002).

Computers can facilitate collaborative according to Crook (1996) by providing pupils with a common benchmark that supports comprehension by groups. Computer group learning assignments seek to increase relationships between students (King, 1989). The group's attention is concentrated on a shared item (Crook, 1999; O'Malley, 1995; Puntambekar, 2006; Stahl et al., 2006). Students interact further with activities in cooperative groups while they work on computer tasks (Jonassen & Kwon, 2001; Poole & Zhang, 2005).

In recent years, collaborative computer learning in the form of CSCL environments has been extended to a new dimension. The CSCL settings can work together to build knowledge through a joint interface support and collaborative problem solving and knowledge creation (Jonassen & Kwon, 2001; O'Malley 1995; Wang, Hinn & Kanfer 2001), and students can collaboratively build knowledge.

CSCL: issue solving in the Knowledge Forum for the Scaffolding Group. CSCL environment demands help for students in their computer problem solving, group work and problems solving within online groups. The Knowledge Forum® program helps students solve online problems by collaborating using the shared interface to generate knowledge (Hakkarainen, Lipponen, Jarvela, & Niemivirta, 1999; O'Malley, 1995; Wang et al., 2001).

However, a great many of the recent studies are centered on cooperation via the computer or on computer-based collaborative learning (CSCL). When Blair (2002) published his first CSCL book, most chapters described computer based experiments. Five years later, in the CSCL 2 book nearly every chapter describes "computer collaboration" experiments (Cruickshank, 2006). The use of computer networks in education and training has increased explosively in recent years. Typically, the technical applications utilized in CSCL offer opportunities for document exchange and a number of special network communication capabilities. The communication tools can be supported by synchronous media like chat, voice

mail, one-line visualization tools and video conferencing (Jukka, 2000).

Computer environments can be utilized as instruments for visualizing thought processes in various ways. The write communication within a learning platform shows the history of conversation, so that collaborative processes can be strongly affected. However, many requests are more extensive and aim to make external actions and qualitatively different contributions visibly visible, for example in the investigative process (McKenzie 1995; Tipton, 1998). McKenzie (1999) proposed that a style of learning which may help new ways of thinking and investigating schooling could be developed through computer-supported collaborative transformative communication. It seems that written communication, together with face-to-face contact, is more effective for the transformative communication than face-to-face communication, as it needs a broader thought process (Williams, 1993).

The two argues that social contact in conjunction with the technological cultural instruments provide new cognitive resources for human cognitive achievement are Windschitl (1998). Miyake's analysis shows that understanding is Iterative in Nature, that is to say that the processes and mechanisms examined arise through a number of attempts to explain and comprehend. Agent with partial but diverse information on this subject seem to improve their understanding by social engagement in a joint problem-solving process.

4. Conclusions

The results of this study indicate that VLE-based CSCL has been carried out successfully and is very useful in distance learning, especially during the current covid-19 pandemic. Based on these results, it is recommended to develop a VLE-based CSCL to see its impact on mathematics learning in schools, especially the impact on problem solving skills.

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