

PAPER

Collaborative Virtual Learning Environments: A Structure for Designing Digital Educational Materials

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2008007@hnpi.edu.cn**ABSTRACT**

Collaborative learning (CL) is primarily conducted in-person meetings these days. It is explained in more detail by identifying key aspects and benefits. Furthermore, social dimensions of learning are discussed, with an emphasis on communication and interaction. Therefore, the theoretical underpinning of educational environments is shared learning. An overview of virtual learning communities and prerequisites for participation are provided. This paper's goal is to offer a few pieces of research on students and cooperative learning in virtual environments. Educations on cooperative learners in virtual environments are beginning to appear and will become more important, especially in online and remote learning contexts. It will be argued that virtual worlds' layout and functioning offer a collaborative platform, especially for students who may have grown accustomed to and even prefer digitalized learning environments. Additionally presented is the environment's design. This environment has been assessed using a hybrid evaluation methodology to identify usability challenges, gather additional requirements for new functionality to facilitate collaborative virtual learning environments, and assess the suitability of various learning scenarios.

KEYWORDS

collaborative learning (CL), virtual learning, educational environments, social aspects of learning

1 INTRODUCTION

The word “collaborative learning” (CL) refers to a broad category of instructional strategies that involve the simultaneous mental and cognitive work of several teachers and students. Students are accountable to one another for their actions, have a similar objective, and rely on one another for success or failure. Investigation has proved the efficacy of learning together in various circumstances compared to other educational techniques (e.g., competition or personalized education). The aforementioned researchers believe that collaborative tasks, centered on a cognitive aim and backed by specialists, lead to the more meaningful and efficient acquisition of information [1].

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Many theories of education, including constructivism and social learning, have been developed as a result of this kind of work. The fundamental tenet of social learning theories, as put out by their principal proponent, Vygotsky, is that “learning and developing is a social, collaborative activity.” In general, collaborative education has a wide range of possible pedagogic advantages. Learners can be encouraged to negotiate material such as intangible, ill-defined, and difficult-to-access information and open-ended issues by using this instructional technique (see Figure 1).

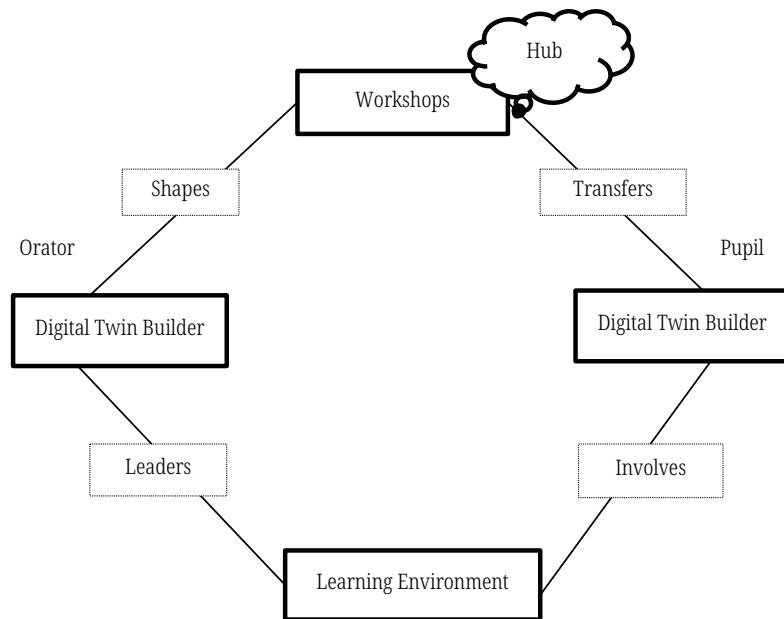


Fig. 1. Cooperation in virtual reality learning environments

New advances in Internet technology, such as faster data transmission rates and wider bandwidths, have made it possible for developers to create CVLEs that integrate excellent multi-media communication (MMC) features [2]. It is anticipated that MMC tools, such as audio and video instruments, will provide learners with richer material so they may convey their thoughts and ideas more naturally [3]. Despite providing technology support for innovative teaching methods, our observations and the findings of studies published in research also demonstrated that CVLEs are difficult to integrate into conventional classroom settings. There are several technological and sociological obstacles that must be solved.

For the remainder of the paper, this format will be followed. Section 2 presents the aim of this work, its scope, the systematic review, and the meta-analysis technique. The description of collaborative virtual learning environments is provided in Section 3, along with an example of relevant mobile applications. In Section 4, the application of learning in performance evaluation metrics to mobile technology is discussed in detail and how it improves outcomes. The conclusion and future enhancements are presented in Section 5.

2 RELATED WORKS

The equal participation effect has been attributed by some researchers to a decline in involvement, a result that has also been documented in the literature on computer-mediated CL. There isn't much student interaction, according to

the findings. But more lately, studies have surfaced casting doubt on this optimistic assessment of computer-mediated cooperation. There is no evidence of an equal participation effect when groups communicate through computer-mediated interaction, according to several studies [4]. As a result, some researchers have abandoned this optimistic perspective on computer-mediated communication in favor of exploring the challenges and solutions associated with utilizing it to promote teamwork.

Numerous studies were carried out to determine the efficacy of those environments with regard to the kind of content, the method of teaching and learning, and the learning results. In order to evaluate and provide the methodologically best information, met reviews offer pre-filtered data [5]. These studies cut down on the time and effort needed to find the studies, evaluate them, and then synthesize them. As a result, this investigation makes an effort to compile research on design and research-related challenges in 3DVLE. This study combines a number of previous studies to examine current developments and patterns in 3DVLE development.

In order to create a people-centric atmosphere rather than a content-centric one and foster meaningful interactions between educators and students, a social networking architecture was employed. The website was a private, secure system that was only accessible by the instructors, students, and researchers. A complex access-permissions structure on the site permitted varying degrees of access to co-workers, workspaces, folders, and files inside project regions. The majority of access controls were kept up to date by the project group leaders or individual members [6]. The pupils were able to customize and manage the environment with the help of the program. Advanced Web 2.0 tools were used on the site to provide easy-to-use collaborative access to a variety of productivity applications. The goal of the network was to serve as the electronic “glue” that connected tasks, ideas, subjects, and information.

In collaborative education, team members typically engage in “natural” interactions without following pre-established frameworks [7]. In contrast, cooperative interaction typically makes use of specific design structures to support group performance. According to recent research, cooperation does not always happen when individuals are working in an identical online setting. As a result, effort must be taken to enhance CSCL’s learning outcomes and connections. According to recent research, establishing a team may be necessary to create successful collaboration. It’s not simple to structure collaboration, though.

Constructivism is an alternative to the pedagogical one-way model, which views learning as an individual act. Constructivism views learning as a collective outcome of social interaction rather than an isolated behavior. By “anchoring” previously acquired knowledge to the differing perspectives, comprehensions, and experiences of others, new knowledge is created [8]. Establishing a community of socially interdependent students—a learning community—is necessary for the implementation of such a pedagogical paradigm. In traditional “face-to-face” schooling, this might occur in a quite spontaneous and natural fashion, but in a DE setting, software products must specifically address the nuances of building solid, dependable, and supporting social interactions.

Learning communities could benefit from the usage of meeting-focused technologies and multi-user VR technology. But there are a lot of challenges with the e-learning apps that are now available that need to be fixed. A few of the primary drawbacks are the absence of peer interaction and learners’ or users’ working alone, as well as the requirement for adaptable, readily available tutorial support. Furthermore, because multi-user VR technologies primarily provide text chat interaction and user representation through avatars, their theoretical advantages are not fully utilized [9]. Advanced communication options such as speech or user gestures, for instance, are not frequently used.

Numerous empirical studies have looked at the effects of CSCL using a variety of metrics, including social interaction, individual perceptions, group task performance, and individual knowledge and skill acquisition. Furthermore, CSCL is examined as a learning scenario with several components rather than as a discrete notion. The two fundamental components of CL are computer support and collaboration in learning processes. Moreover, CSCL research frequently incorporates multiple technologies and ancillary tactics, which represent an additional component of CSCL [10]. A few empirical studies have looked into the benefits of teamwork in computer-supported learning environments.

3 METHODS AND MATERIALS

3.1 Cooperative education

The research of student interaction has a long history in pedagogical thought. Numerous recent strategies demonstrate how effective collaborative work is in traditional educational environments. Any form of group learning that involves some relevant learning exchanges amongst students is generally referred to as learning together. If these interactions happen in online settings, we refer to it as virtual collaborative e-learning.

We begin our discussion of CL by asking why it is thought to be an effective method of learning. Different solutions exist on a theoretical or practical level.

We'll display the five fundamental responses below:

1. **Everyday routine:** Everyday observations reveal scenarios ranging from kids working in groups to address problems cooperatively to kids writing research papers with classmates. When there is a need for individuals to study together, collaborative education can be recognized and should be promoted; other times, it is only seen as a by-product of regular organizational procedures. Therefore, adherence to any organizational philosophy or ideology is not always desired when working and learning together under collaborative circumstances.
2. **Institutional:** It is standard procedure to accomplish tasks by assembling interdisciplinary teams, specialists, etc. In these situations, the difficulty lies in encouraging each person to contribute their area of knowledge so that the group can grow and collaborate. Over an extended period, CL amplifies the worker's capacity to develop teamwork and decision-making abilities within the company. These abilities could make it easier for people to work and collaborate in the workplace with peers, bosses, and other staff members. Senge's organizational theory and the learning organization method are thus greatly influenced by collaborative learning.
3. **Theory of learning:** There are well-established theoretical justifications for thinking that CL models are highly successful as teaching tools. The distinction between short-term effectiveness—learning the material that is the focus of a particular CL environment—and long-term effectiveness—the (purported) improvement of cognitive abilities, self-esteem, and other soft skills through CL—is also evident here. These soft skills are regarded by several theorists as prerequisites for long-term effective learning.
4. **Practical:** According to research, cooperative learning is superior to individual and competitive learning environments in that it increases students' achievement levels, improves their problem-solving skills, provides cognitive benefits, and fosters the growth of beneficial personality characteristics that will help them in

the future when it comes to acquiring knowledge and working autonomously or cooperatively.

- 5. **Moral:** Individuals are empowered by CL, which also makes it possible for them to lead more independent, cooperative, and fulfilling lives in the future. This response has mostly come from radical viewpoints such as critical education and other extreme critiques of the current educational systems, and it applies to adults as well as kids.

This succinct review highlights several theoretical methods in the field of CL and demonstrates how effective it is as a daily paradigm for working and learning together. The aforementioned crucial challenges highlight the need for institutions, tutors, and students to develop the ability to deal with the method of CL. They mostly relate to frameworks, roles, and individual learning styles. They also highlight the significance of CL groups’ mediation.

As we’ll see later when we talk about virtual communities, mediation is crucial, and even the function of the “teacher” shifts to that of a “tutor” or “direct.”

3.2 A plan for implementing mobile social media in the classroom

Several educational affordances of WeChat were found in the data, as was mentioned in the part before this one. A few of these mirrored the recognized benefits of mobile social media that have been documented in the extant literature. Additionally, new opportunities have appeared, such as stimulating environments and meaningful learning. Combining these mobile social media affordances, the suggested framework could be used for instructional purposes (see Figure 2). The RASE pedagogical model, which consists of four components—resources, activity, support, and evaluation—is a student-centered learning design approach that served as the foundation for this framework. The term “resources” describes the information, supplies, and equipment pupils use to complete their assignments. Students get an experience where learning takes place in the context of developing comprehension, putting ideas to the test, extrapolating, and applying knowledge through an “action.” “Support” gives kids a framework while fostering their independence and ability to learn.

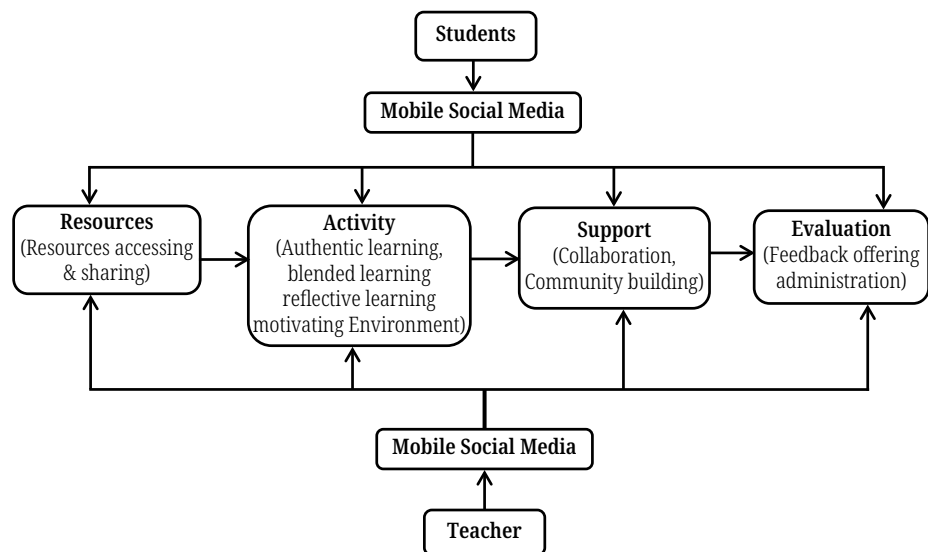


Fig. 2. A plan for implementing mobile social media in the classroom

“Evaluation” seeks to offer organized data to direct students’ development and function as a tool for figuring out what more needs to be done to guarantee that learning objectives are met [11]. The RASE model was not specifically created for the use of mobile social media, despite the fact that it has been emphasized for the design of mobile learning environments. In contrast, the framework provided in this study incorporates mobile social media’s educational affordances into various stages of a learning process, specifically designed to support learning through the usage of mobile social media. This is based on the model’s primary ideas. This is very important, especially in light of the fact that teachers’ pedagogical knowledge plays a major role in the failure to fully use the educational potential of ICTs like mobile social media.

Firstly, because mobile social media makes resources easily accessible and shareable, they can be used as “Resources.” Instructors have the ability to distribute and exchange a variety of materials and topics with their students, including articles, slideshows, and digital media via mobile social media.

Students can seek out the information they need to support their learning using mobile social networks as a tool in the interim. These tools can be used to assist students in their learning activities in a variety of settings, including classrooms and other locations. For example, the official WeChat account was used as a public platform to share, look at, and publish resources related to distant learning. Additionally, learners may be able to access these resources at any time and from any location thanks to the connection aspect of mobile social media.

4 IMPLEMENTATION AND EXPERIMENTAL RESULTS

4.1 Selection standards and evaluation of quality

By concentrating on mobile learning research in academic or business contexts, specific inclusion criteria were established during the original article selection process. Priority was also given to studies examining factors that influence the adoption and acceptance of mobile learning in academic environments. Every study that is chosen must be authored in English and carried out in accordance with the eligibility requirements between 2010 and 2022. Research carried out in educational settings that had no direct bearing on the context of mobile learning was disregarded. An outline of the selection criteria can be found in Table 1.

Table 1. Evaluate the inclusion and exclusion standards

Inclusion Criterion	Exclusion Criterion
Mobile learning-related keywords	Mobile learning employed in different contexts
Learning or teaching keywords	Review, theses, and non-peer review articles
Written in English	The paper was published in a language other than English
Published between 2010 and 2022	

Apart from the predetermined inclusion and exclusion standards, the chosen articles underwent a thorough assessment procedure that included a quality assessment checklist with nine distinct criteria (N = 269). Rather than being a tool for critiquing the work of earlier researchers, the checklist was developed as a comprehensive indicator of study quality, drawing inspiration from Kitchenham and Charters. On a three-point rating system, “Yes” was worth 1 point, “No” was worth 0, and “Partially” was worth 0.6 points for each criterion.

A greater degree of agreement with the research questions was indicated by higher values in the final cumulative score, which varied from 1 to 8. To represent the SLR, a preferred reporting items for systematic assessments and meta-analysis (PRISMA) chart was created (see Figure 3).

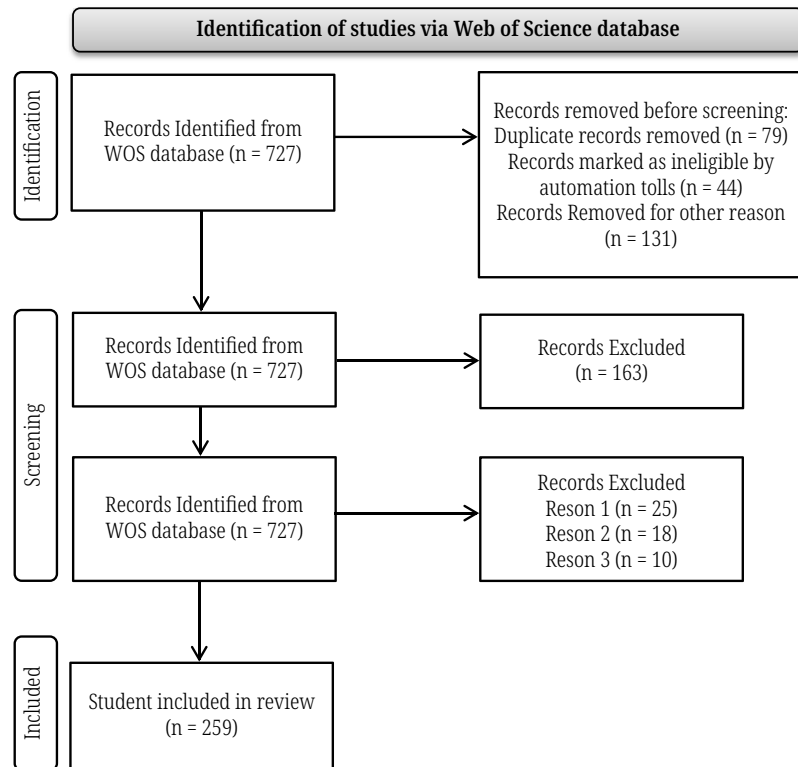


Fig. 3. The schematic diagram of PRISMA

4.2 Bibliometric evaluation

Bibliometric analysis is the next phase in the SLNA approach. It is a quantitative instrument used to assess different academic journals or authors using citation metrics.

Before performing bibliometric analysis, it is essential to precisely define the article selection criteria in order to avoid any misunderstandings regarding the perception of quality. The analysis uses both quantitative and qualitative statistical methodologies to examine the publication content, references, citations, and co-authorship dynamics. The multifaceted method makes it easier to look into developing themes, author networks, knowledge domains, citation trends, reader engagement, and the overall importance and influence of the topic. The trends and relationships in the field of mobile learning research were evaluated in this study through the use of bibliometric analysis. Performance analysis and science mapping were the two categories into which the results were separated.

4.3 Publications patterns

Figure 4 displays the publication trend in the field of mobile learning research. Furthermore, the graph illustrates the quantity of citations from 2010 to 2022. Between 2010 and 2016, a mere 53 publications were found, or 30% of all publications. Notably, from 2016 onwards, an exponential rise in publications was noted, accounting for

almost 70% of all publications. Additionally, the number of citations from 2010 to 2022 is shown in Figure 4 [12]. Over 1600 citations were made to the publications published in 2012; however, in the years that followed, the citation patterns decreased.

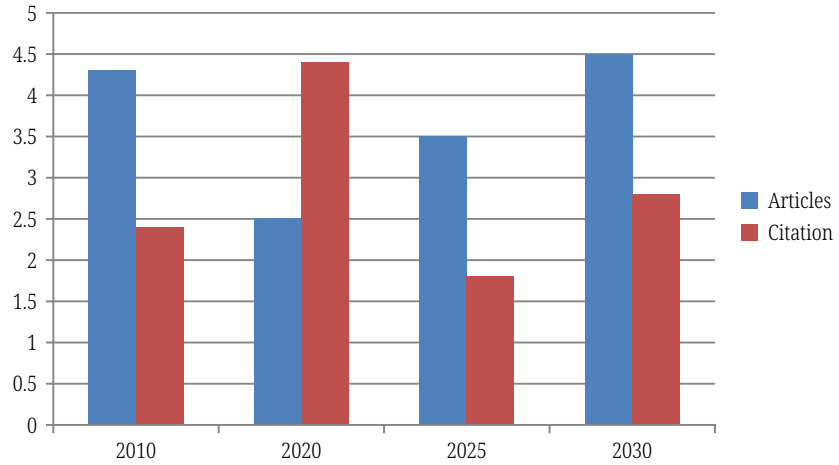


Fig. 4. Trends in publications and citations

4.4 Influential journals

A total of 249 publications on mobile learning from 104 different journals are included in this review analysis. Table 2 lists the top 10 journals that have published 76 publications on the topic in total. The journals with the highest volume of publication are specifically *Computer & Education* [13], *International Review of Science in Open and Distance Learning*, and *Education and Information Technologies*. The publishing impact of *Computer & Education* was 1009, with the *British Journal of Educational Technology* contributing 551 citations and the *International Review of Research in Open and Distance Learning* contributing 757 citations. Mobile learning gained a lot of traction from some of the most important journals in the industry, as evidenced by the fact that most of the top contributing journals had an impact factor larger than one and were included in business and management databases.

Table 2. Journals with the most impact

Journal Title	JIF (2021)	TP	Impactful		
			TC	h-Index	g-Index
<i>Education and Information Technologies</i>	3.66	15	212	8	13
<i>International Review of Research in Open and Distance Learning</i>	1.24	12	757	8	12
<i>Computer & Education</i>	11.18	10	1009	8	10
<i>IEEE Access</i>	3.47	10	74	5	8
<i>Interactive Learning Environments</i>	4.96	9	149	6	9
<i>Educational Technology and Society</i>	2.63	8	341	6	8
<i>Australasian Journal of Educational Technology</i>	3.73	7	290	5	6
<i>International Journal of Engineering Education</i>	0.97	5	47	3	5
<i>British Journal of Educational Technology</i>	5.26	5	551	4	5
<i>Computer Applications in Engineering Education</i>	2.1	5	23	3	4

4.5 Important journals and nations

The topic evolution of mobile learning on a selection of articles from 2010 to 2022 is depicted in Figure 5. To conduct the analysis, the time period was divided into three periods: 2010–2016 [14], 2017–2020, and 2021–2022. The box height in the thematic progression indicates the presence of keywords, while the line thickness indicates the relationship with other themes.

Between 2010 and 2016, 69 publications in all were found. The education and technology domains, in particular system design and self-efficacy, were the focus of mobile learning research.

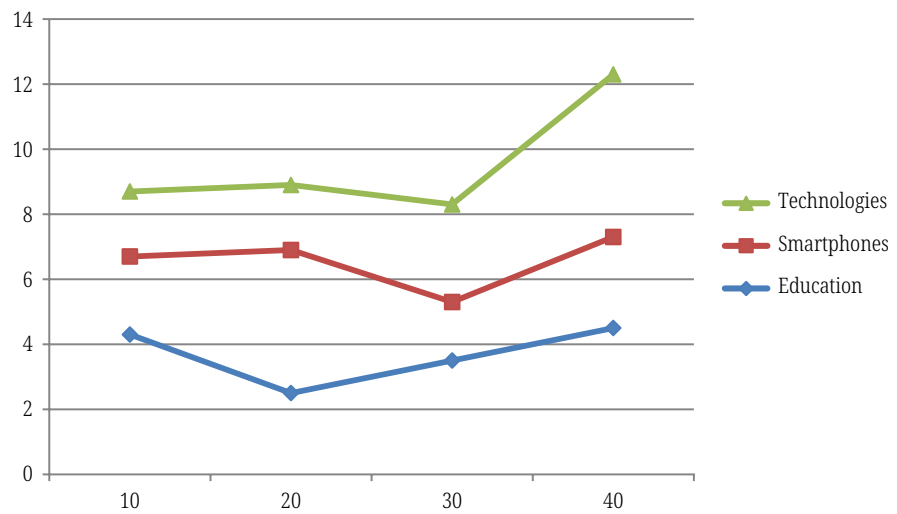


Fig. 5. The thematic development of mobile education between 2010 and 2022

The mobile learning theme map, arranged into four quadrants (Q1 to Q4), is shown in Figure 6 [15]. The bottom left (Q3) and right (Q4) quadrants indicate developing or fading and underlying concepts, while the upper right and left (Q1 and Q2) indicate driving and specialist themes, respectively. The analysis revealed that acceptance and adoption of mobile learning were the key themes that needed further investigation by scholars in the future.

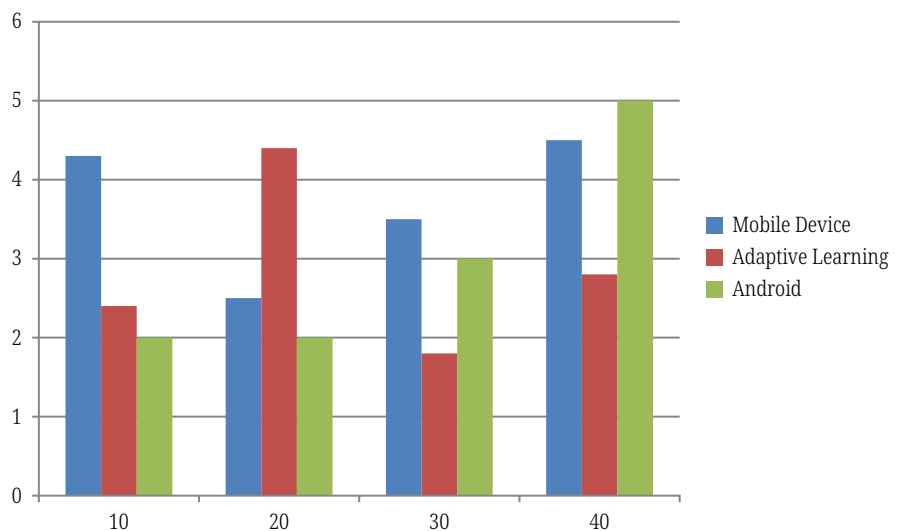


Fig. 6. The research theme map for mobile learning

5 CONCLUSION

Three degrees of virtual cooperation between teachers were made possible and limited by the practice architectures: the classroom, school, and regional levels. This pilot project was made possible by prior teacher and school collaboration. The ramifications align with earlier studies emphasizing the value of institutional support for teacher collaboration. The VLE's teacher collaboration provided impetus for innovative instructional strategies and ongoing professional growth. But for VLEs to become a part of instructors' daily practice architectures, pertinent teaching practices must be made possible. Collaboration amongst school administrators can foster long-term teacher collaboration, informal support, and increase faculty members' didactic and digital competency. Enough infrastructure cannot be provided in rural areas without regional support. The teacher collaboration clusters have the expertise and involvement needed to carry out such projects.

Therefore, additional empirical research on the educational potential of WeChat and other mobile social media platforms in many topic areas might be done. Fifth, further long-term research is required.

In general, the earlier research on mobile social media's educational benefits was conducted in a short amount of time. As a result, longer-term studies should be undertaken in the future to investigate the framework's long-term adoption and validation.

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