Collaborative teaching system based on private cloud disk

Jingqi Li[a,b*], Yijie Bian[a], Yanchi Lu[a]

[a] Business School, Hohai University, Nanjing, Jiangsu, China; [b] Network and Information Technology Center, Hohai University, Nanjing, Jiangsu, China

ABSTRACT

This paper analyses the insufficiency of the existing teaching system in supporting the teaching collaborative activities, that is, it is difficult to support the teaching supervisory activities, teachers' common courses preparation, the management and storage of students' electronic document assignments, and so on. The idea to utilize private cloud disk to build a collaborative teaching system is suggested. Then it designs the teaching supervision process, course collaboration process and teacher-student collaboration process based on private cloud disk, puts forward the overall framework of Collaborative Teaching System based on Private Cloud Disk (CTS-PCD), and designs its functional structure. Finally, the technical framework and application of CTS-PCD are discussed. The CTS-PCD has good support and reference significance for the current teaching informatization in universities.

Keywords: Private cloud disk, collaborative teaching, course collaboration, teacher-student collaboration

1. INTRODUCTION

With the development of educational informatization, teaching informatization has made great progress. Universities have built teaching management information systems, web-based teaching platforms and teaching resources bases in China. These systems provide very good information technology support for teaching management and teaching process, but insufficient support for teaching collaborative activities.

Collaboration is a synchronous, coordinated activity that is to solve a problem by a continued attempt to construct and maintain a shared conception. Collaboration among teachers means dynamic and interactive, which can be characterized by a process that allows teachers to make decisions jointly on solving mutually problems[1]. There are seven major collaborative activities that require the support of collaborative system, which includes planning, monitoring, assistance, protection, explicit communication, indirect communication, and coordination of actions[2]. Teaching collaboration is mainly embodied in the collaborative behaviour among teachers, teaching administrators and students. Its main activities include teachers preparing courses together, teaching administrators checking teachers' course materials and students submitting electronic documents assignments, etc. Specific collaborative activities mainly include the following three types.

In recent years, with the development of big data technology, non-structured data storage and processing technology have been widely used. In the field of public cloud services, many public cloud disks have been widely applied. But public cloud disk lacks support for the teaching collaborative process, and it lacks support for organization application. Private cloud disk not only has the characteristics of mass, large concurrency, automatic synchronization file storage and sharing similar to public cloud disk, but also is easy to expand and integrate. Its security is more prominent and transmission speed is faster than public cloud disk. Therefore, CTS-PCD can make full use of private cloud disk technology and save the developing cost. It can also achieve the personalized needs of collaborative teaching, which is of great practical significance.

2. RELATED WORK

Collaborative teaching has been adopted as an effective method to promote students' learning. With the way of collaborative teaching, teachers would share responsibility for design, development, implementation, and evaluation of classroom instruction[3]. Some studies have investigated how collaborative teachers contributed their teaching resources, or teaching materials for successful collaborative effort[4-5]. Luo's study[6] examined a collaborative teaching model for

* lijingqi@hhu.edu.cn

English teaching in elementary schools, which is cooperated by native English-speaking teachers and local teachers. This collaborative teaching model is proposed as an effective method to improve the performance of such teaching practice.

In Australia, a collaborative teacher network was formed at a university to improve inter-disciplinary student learning on the complex social-environmental problems. Eight teachers collaborated to make students learn different types of knowledge in a way that was more than the summing of different disciplinary parts. Practice showed the most positive aspect of the collaborative teacher network was the peers' support for teaching innovation[7].

In Singapore and Shanghai, Professional learning communities had been applied as a method of structured teacher collaboration to promote the quality of teaching and learning [8]. In Hong Kong, researchers studied the effect of combining inquiry project-based learning with a collaborative teaching approach on the development of primary students' IT skills and information literacy. According to the collaborative teaching approach, three teachers in different subject areas and a school librarian was involved to guide students' learning. Results showed that such method had a positive impact on the development of all dimensions of the students' IT skills and information literacy[9].

Computer-supported collaborative Teaching\Learning (CSCT\CSCL) has been applied in classroom teaching and learning. CSCL adopts new information technologies to bring teachers and learners together, and provide creative activities of social interaction and intellectual exploration. But CSCL is concerned with face-to-face collaboration too. The overall goal of CSCL is to design software tools and collaborative environments to promote the construction of social knowledge through various methods, theories, functions and structures[10].

Collaborative Teaching/Learning Environment will be useful to both the inexperienced teachers and senior teachers, as it could support their teaching with new coursework, ideas and resources[11]. Pinatti[12] reported knowledge and expertise sharing in CSCW of industrial surroundings. They argued that the use of augmented reality and sensor technology would result in significant new methodological innovations, and the evolution of cyber-physical infrastructures would offer a way of changing some assumptions on how knowledge might be captured and displayed.

With the development and application of information technology, it is needed to develop a collaborative pedagogical culture that counteracts the isolation culture with new definitions of university administrator roles and new procedures[13]. Data-driven decision-making has widely been used to improve retention for colleges by identifying and evaluating strategies[14]. According to Gokmen's study, in their interviews of instructors and administrative post holders from 5 participant universities, 88% of attendants as boards of directors supported continuous cooperation tools，and 40% of attendants as instructors thought that managers were sufficiently using the method of sharing data and information[15].

So, as a conclusion, the application of IT in education, especially in higher education, has been paid more and more attention. Collaborative teaching has been adopted by more and more schools and welcomed by teachers.

3. METHOD

Our study is based on a product that can provide private could disk service. But the product only supports document management, without supporting the process of teaching collaboration. According to the methodology of software engineering, we researched the need for teaching collaboration and the advance of Computer-Supported Cooperative Work (CSCW), and then combined teaching collaboration with private could disk. We designed the process of teaching collaboration, overall framework and main function modules of CTS-PCD. Then we collected some advice for the system after it had been applied in our university. At last, we discussed its application in universities.

4. DESIGN

According to different collaborative objects, the collaborative teaching process can be divided into three types: teaching supervision process, course collaborative process and teacher-student collaborative process. Teaching supervision refers to the process that the teaching administrator supervises the teaching process; course collaboration refers to the process that teachers cooperate to prepare courses and complete the construction and sharing of teaching resources; teacher-student collaboration refers to the process that teachers share teaching resources with students and collect electronic documents assignments. Such a process chart is shown in Figure 1.
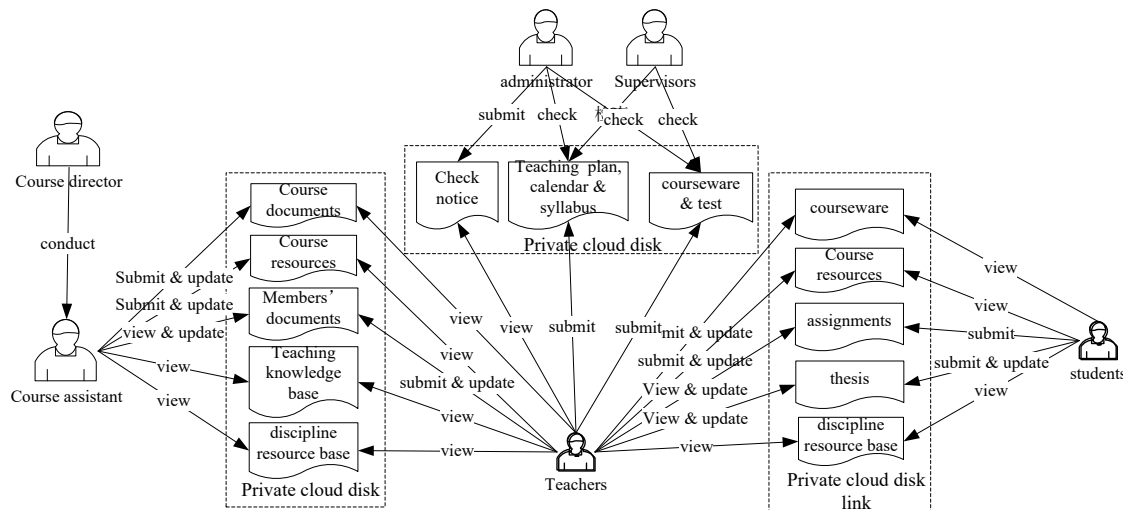
Figure 1. Teaching collaboration process.

4.1 Teaching supervision

In the traditional management process, teaching supervision is mainly the activity of checking teachers' preparation for courses and attending classes. The process of teaching supervision is mainly based on offline processes, but cannot be completed online. For example, teachers' lesson plans, courseware, teaching materials and so on are mostly electronic. However, in order to cope with the check, it is necessary to print these materials and waste a lot of paper. On the other hand, these paper materials are only used for a check, but teachers use electronic courseware to teach in the class, so the teaching supervision would turn into meaningless things. With the support of private cloud disk, electronic teaching plans and teaching resources can be shared with teaching administrators. Although the teaching management system has advantages in process management, it lacks huge space for storing documents. Private cloud disk has the capacity for massive storage expansion, so the teaching supervision process can solve the problem of document management and storage space. After the teaching administrator issues check notice, teachers who need to be checked would submit the teaching material to check folders. Teaching administrators can check relevant documents and materials. The supervising group would be directly granted the privilege to browse the corresponding folders, and can directly evaluate and score in the system. In this way, the teaching administration department can optimize the process of teaching supervision and improve the efficiency of teaching supervision.

4.2 Course collaboration

Course collaboration includes teacher team organization, role assignment, and automatic generation of member folders. For the course team, the course folder can be automatically generated at the time of creation, and the folder of each member can be automatically generated at the time of adding the user into the team. The member folder is used to store the documents shared by members. At the same time, the roles can be divided into (1) course director: with the overall course management authority, can manage all documents in the course folder, including the documents in each member folder; (2) course assistant: with all the authority of course management, can assist the course director in the management of course projects; (3) course members: have full CRUD (Create, Retrieve, Update, and Delete) permissions for personal folders and files, and other folders and files have different permissions based on permission settings.

4.3 Teacher-student collaboration

Teacher-student collaboration process is mainly the coordination between teachers and students. Because of the large number of students, the sharing of teaching resources and the collection of electronic document assignments by means of file sharing in private cloud disk are too cumbersome. It is a complicated operation process for both teachers and students. In view of the complexity of user restriction and management of private cloud disk, external contact is an ideal way to cooperate between teachers and students. When teachers need to share teaching materials with students, they can set up a download link, which is set to only access and download files. When teachers need students to submit their assignments, they could firstly set up a dedicated folder on private cloud disk to store electronic document assignments,

and then set up an upload link in the folder, allowing only the use of the link to submit documents and view lists, but cannot to view, update, delete and download the documents. This avoids the cumbersome problems for electronic assignments to upload/download on the traditional web-based teaching platform, but also solves storage space problems for electronic assignments submission by mail or QQ. Another common scenario is that teachers instruct students to write the thesis. If both sides need to edit the papers, a folder can be set up firstly, and then a cooperative link can be set in the folder. Then students can add and modify the papers. Teachers can also review the papers and complete the cooperative editing.

4.4 The overall framework of CTS-PCD

The CTS-PCD includes two parts: private cloud disk and collaborative teaching system. Private cloud disk achieves the functions of document management, system security and system log auditing. A collaborative teaching system realizes the process of teaching supervision, course collaboration and teacher-student collaboration.

The main functions of the private cloud disk include (1) file management: upload, download and store personal files. (2) shared file management: to achieve shared files CRUD access by managing shared folders and files. (3) External link Management: External links can be established for folders and files to be shared with external visitors, thereby expanding the scope of private cloud disk use, and can set CRUD permissions on the external link.

The collaborative teaching system includes three application aspects and two general functions. The application of the three aspects includes teaching supervision, course collaboration and teacher-student collaboration, which support the three collaborative processes of the upper level. The two general functions mainly include teaching knowledge base and discipline resource base. The teaching knowledge base provides teaching-related knowledge materials, including various teaching and research papers, teaching experience documents and so on. Discipline resource base provides the professional resource base based on various disciplines, as well as the assignments and examination papers accumulated by teachers in schools, as shown in Figure 2.
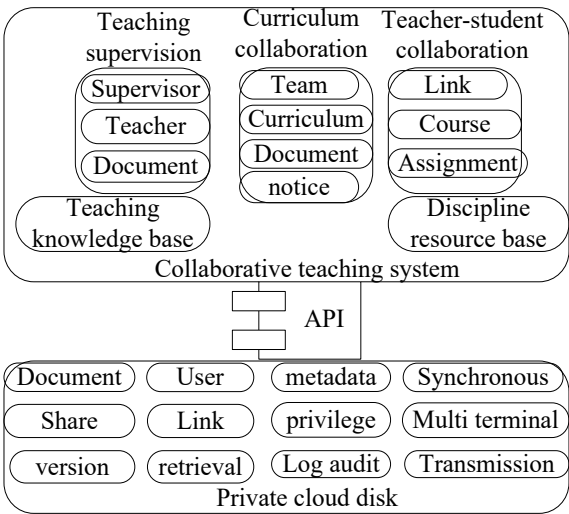

Figure 2. Overall framework of CTS-PCD.

4.5 Function Design of CTS-PCD

As far as the main function is concerned, the CTS-PCD is centered on course construction. It can improve work efficiency by making course construction plans, assigning course construction tasks, sharing course construction resources and supporting the real-time document interaction of teachers. The function of CTS-PCD mainly consists of three functional categories and nine main function modules, as shown in Figure 3.
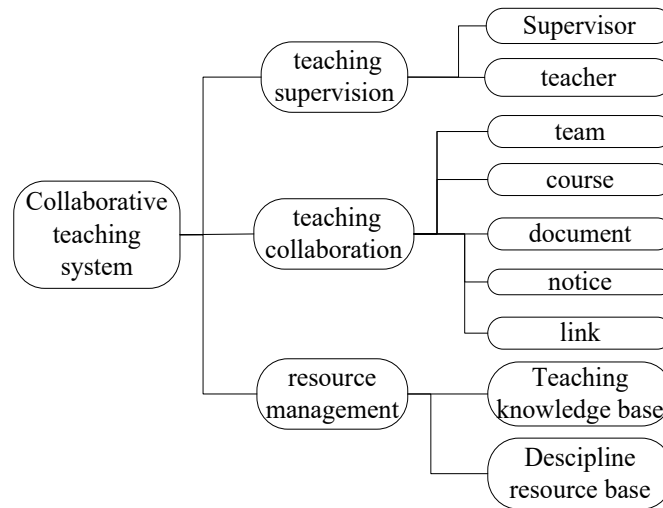
Figure 3. Function modules of CTS-PCD.

The three functional categories of the CTS-PCD include teaching supervision, teaching collaboration and resource management. Teaching supervision is based on the technical realization of teaching supervision process. Teaching collaboration is the support of collaborative behaviours in the teaching process. Resource management is the management of teaching resources.

(1) Teaching supervision module

In the CTS-PCD, its main function is to realize the management of supervision groups and teachers. The supervision management mainly establishes several supervision groups, corresponding to different disciplines, in order to give access to the teaching document folder. Teacher management is mainly to establish a sample group of teachers, so as to give these teachers the permission to submit teaching inspection materials in the teaching document folder. Sampling teachers submit teaching materials according to the requirements, and in view of teachers' copyright awareness, the folder permissions should be set to only view online. Excellent teaching documents can be collected to form an excellent case set for other teachers to learn from.

(2) Teaching collaboration module

In the CTS-PCD, team management provides team-building tools, and course directors can add relevant teachers to the course project after establishing the project. Then the roles of the course project personnel are defined, including the course director, assistant and members. The user who generally establishes the course project is the person in charge of the course. The course director has all the permissions for the course project. The course assistant assists the course director to manage the teaching folders and documents. The course members work together. Course management provides the functions of creating, issuing notices and managing course documents. Document management is based on the private cloud disk, and teachers manage their own documents. Notice management is a tool for notification and daily contact in course building. External link management is mainly used to collect students' assignments and share teaching resources with students. By establishing an external link on folders with only access and upload permissions, students can submit their assignments through the external link.

(3) Resource management module

Resource management module mainly provides teachers with teaching knowledge and resource support, including teaching knowledge base and discipline resource base. A teaching knowledge base is a kind of knowledge resource that may be involved in all teaching activities, such as educational theory, multimedia courseware skills, and so on. The knowledge base not only provides these knowledge documents, but also encourages teachers to share their teaching experience. Discipline resource base directly provides teaching resources for teachers of the same discipline, such as teaching video, programming software and so on. Through the discipline resource base, CTS-PCD can continuously accumulate some courseware and video produced by teachers themselves, and these teaching resources have higher application value because they are in line with the actual teaching of their school.

The main function of CTS-PCD is teaching collaboration. Teaching supervision and resource management provide supervision and resources. At the same time, teaching administrators also need to actively develop teaching resources, actively build teaching knowledge base and discipline resource base. The construction of the teaching knowledge base and discipline resource base is a long-term process. It needs not only the unremitting efforts of the teaching administration department, but also the active contribution of teachers' achievements and knowledge.

5. APPLICATION AND DISCUSSION

5.1 Technical architecture and development

We use four high-performance cloud storage machines to realize the function of private cloud storage. Each machine is equipped with an 8-core CPU, 128G memory and 48T NL-SAS hard disk. Raid10 is used to ensure that the hard disk data is not lost. The technology of documents double-backup is implemented in software and the data is automatically de-duplicated. Such architecture not only ensures data security, but also achieves save storage space, and optimizes the user experience. Through the unified identity authentication system (IDS) to achieve integration with the school information portal, support the terminal such as WEB, PC, and mobile phone. Through the unified communication system (UCS), the collaborative messages can be timely sent to the relevant users through e-mail, short messages and other ways as shown in Figure 4.
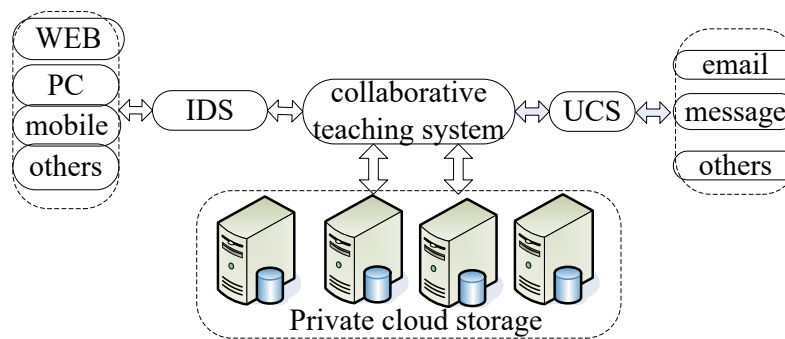

Figure 4. Technical architecture of CTS-PCD.

J2EE architecture is adopted for development and implementation. The underlying database adopts Mysql, and Ehcache is used to improve the caching capacity. Ehcache is an open-source distributed caching framework implemented in Java, which can effectively reduce the load of the database, save the data in the memory of different servers, and quickly access the data when needed. The middleware uses Tomcat, the development framework uses Spring+SpringMVC, and the data persistence framework uses Hibernate and Redis. As an in-memory data buffer system, Redis has high performance, and the data in Redis can be persisted to disk as needed, so that the data can be recovered after the server is restarted. In terms of presentation, based on the emerging HTML5, CSS3 and mobile technologies, combined with JS, AJAX, XHTML, DIV and other technologies, the mature open-source framework is used for user interaction processing of business system.

5.2 Teachers' behaviors analysis

We collected the log files of teachers' behaviour on CTS-PSD to analyse how teachers apply CTS-PSD in collaborative teaching. From the log file, we found there are only 29 users who had been used CTS-PSD to share files. This means teachers are not easy to share files with others. And the log file also shows there are an average of 18 days for users to first upload the file since the first login date. There is an average of 21 days for users to first download the file since the first login date. But the average length for users to first share the file since the first login date is 78 days. It is a long time for users to share the file. But users are easy to upload files and download files by CTS-PSD. Then we analyzed the correlation among login count, upload count and download count. The result is as Table 1.

Table 1. Correlation among teachers' behaviors.

	logincount	uploadcount	downloadcount
logincount	1.0000		
uploadcount	0.2219* 0.0326	1.0000	
downloadcount	0.4503* 0.0000	0.2489* 0.0161	1.0000

*$p = 0.05$

From the log files, we find the download count is correlated to the login count ($r = 0.4503$, $p = 0.0000 < 0.05$). Considering the samples are true data in the natural application environment, such correlations are reliable in the study. So how to encourage teachers to log in to the CTS-PSD is the key to making CTS-PSD maximize its usage.

We adopted three ways to encourage teachers to use CTS-PSD. First, we hold the teaching meeting at least one time a year. Secondly, we enlarge teachers' space size to 100G, so that teachers are willing to upload their files. Thirdly, we suggested the academic office make its tracing data as an index item for teaching evaluation.

5.3 Discussion

Information use is heavily situated and socially contextualized. For practitioners, one could not focus on the technology alone. In the designing and application of CTS-PCD, we find collaborative teaching is urgently needed in universities. Teaching administrators think it can improve the level of supervision and the effectiveness of teaching. Teachers think it can improve the efficiency of preparing courses and save their time. Students think it can be easy to download the teaching materials and upload electronic assignments, and they can complete the assignment with the guidance of teachers. The interaction feels is not got by online exercises. Online exercises relax teachers but they cannot relieve the burden of students. Making exercises online is boring and tasteless for most of the students, but with the teachers' interaction, students would feel the care of teachers. Learning is not only learning knowledge but also learning to live with. In our times, making exercises collaboratively is more important than individually. So students should make exercises with partner student or their teacher collaboratively.

In our perspective, Collaborative Teaching includes three aspects, one is teaching supervision, one is preparing course materials together and the other is completing the assignment with students. This expands the context of Collaborative Teaching, not restricted to the two teacher's co-teaching activities. And in the application, CTS-PCD as software has wide use context, and can support several activities in the teaching process. CTS-PCD relieves the burden of teachers' work from three aspects. Firstly, collaborative work can make teachers only complete a part of the work of preparing teaching materials. Secondly, collaborative work makes teachers interact with other teachers and improve the quality of teaching materials. Thirdly, a collaborative editing thesis can improve students' level and may inspire the teachers.

6. CONCLUSION

The CTS-PCD, guided by the teaching collaboration process, provides all-around support for teaching collaboration through the ubiquitous access of documents and seamless docking of the teaching collaboration process. The system realizes the convenient storage of teaching document resources and the co-creation of teaching courseware, and creates a highly reliable collaborative system for the storage and sharing of teaching materials.

The significance of CTS-PCD is to solve the problem that the previous teaching platform cannot edit the document collaboratively. Teachers can use CTS-PCD to edit teaching documents together. Teaching documents are the most widely used form of teaching materials in the current teaching practice. Moreover, the private cloud disk provides support for massive document storage for teaching collaboration. Under the existing private cloud storage architecture, when the storage is difficult to meet the demand, adding cloud storage machines directly can realize the lateral expansion of storage resources.

The CTS-PCD is also conducive to the integration and utilization of teaching resources, and can be organically combined with the teaching management system, web-based teaching platform. The teaching resource base improves the utilization of resources. The teaching management system provides teachers and course data for the collaborative teaching system. CTS-PCD supports the sharing and access of documents in the web-based teaching platform. CTS-PCD also provides storage space for large files for the resource library. In this way, all kinds of teaching systems cooperate with each other so that they can play a greater role in providing a better information-based environment for teaching.

ACKNOWLEDGMENTS

REFERENCES

[1] Johnston, S., Tulbert, B., Sebastian, J., Devries, K. and Gompert A., "Vocabulary development: A collaborative effort for teaching content vocabulary," Intervention in School and Clinic, 35(5), 311-5 (2000).

[2] Gutwin, C. and Greenberg, S., "The mechanics of collaboration: developing low cost usability evaluation methods for shared workspaces", IEEE Int. Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises, IEEE Computer Society, pp 98-103 (2000).

[3] Welch, M., Brownell, K., and Sheridan, S., "What's the score and game plan on teaming in schools," Remedial and Special Education, 20(1), 36-49 (1999).

[4] Dugan, K. B. and Letterman, M. R., "Team teaching a cross-disciplinary honors course: Preparation and development," College Teaching, 52(2), 76-9 (2004).

[5] Kluth, P. and Straut, D., "Do as we say and as we do: Teaching and modeling collaborative practice in the university classroom," Journal of Teacher Education, 54(3) 228-40 (2003).

[6] Luo, W. H., "An inquiry into a collaborative model of teaching English by native English-speaking teachers and local teachers," The Asia-Pacific Education Researcher, 23(3), 735-43 (2014).

[7] Pharo, E. J., Davison, A., Warr, K., Nursey, B. M., Beswick, K., Wapstra, E. and Jones, C., "Can teacher collaboration overcome barriers to interdisciplinary learning in a disciplinary university a case study using climate change," Teaching in Higher Education, 17(5), 497-507 (2012).

[8] Hairon, S. and Tan, C., "Professional learning communities in Singapore and Shanghai: implications for teacher collaboration," Compare: A Journal of Comparative & International Education, 47(1), 1-14 (2016).

[9] Chu, S. K. W., Tse, S. K. and Chow, K., "Using collaborative teaching and inquiry project-based learning to help primary school students develop information literacy and information skills," Library & Information Science Research, 33(2), 132-43 (2011).

[10] Gress, C. L. Z., Fior, M., Hadwin, A. F. and Winne, P. H., "Measurement and assessment in computer-supported collaborative learning," Computers in Human Behavior, 26(5), 806-14 (2010).

[11] Stylianou, V. and Savva, A., "Collaborative teaching environments," Global Engineering Education Conf. IEEE, pp 1727-30 (2017).

[12] Aparecido Fabiano Pinatti de Carvalho, Sven Hoffmann, Darwin Abele,Marcus Schweitzer, Peter Tolmie, David Randall and Volker Wulf, "Of embodied action and sensors: Knowledge and expertise sharing in industrial set-up," Computer Supported Cooperative Work (CSCW), 27, 875-916 (2018).

[13] Nevin, A. I., Thousand, J. S. and Villa, R. A., "Collaborative teaching for teacher educators—What does the research say," Teaching & Teacher Education, 25(4), 569-74 (2009).

[14] Picciano, A. G., "The evolution of big data and learning analytics in American higher education," Journal of Asynchronous Learning Networks, 16(4), 9-20 (2012).

[15] Dagli, G., Silman F. and BIROL, C., "A qualitative research regarding the university administrators' capacity to use of management information tools," Procedia-Social and Behavioral Sciences 1(1), 2480-90 (2009).