Title	Usage of Collaborative Learning Environments Culminating in Practical Applications
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論 文 内 容 の 要 旨

氏 名 （ 孫 帙 ）	

論文題名	Usage of Collaborative Learning Environments Culminating in Practical Applications （実践への応用を目指した協働学習環境の活用

論文内容の要旨

Students accustomed to school tasks that can be solved just by reproducing knowledge or recalling examples from a textbook are not well prepared for the "ill-structured" problems faced in workplaces or in daily life that involve more creative, collaborative, and self-directed activities. This research set out to explore a way to construct collaborative learning environments to meet the changing needs of the real world and engage students to build their own knowledge and solutions to these ill-structured problems with the ability to apply them to practical applications. This research was conducted to explore the necessary conditions for collaborative learning environments to promote practical knowledge building, to develop an approach that incorporates these conditions, and then implement the proposed approach in a real educational setting with students using their newly gained knowledge for a real world application.

Three main goals of this research were:

First, to analyze previous studies on learning environments and pedagogical issues related to collaborative learning environments construction. In particular, the focus was on "practical knowledge" which hasn't been taught well in the current education system (Stanley, J. & Williamson, T, 2001). Once the causes for this could be understood, the conditions necessary to remedy this could be determined. Secondly, to capture the distinct features of the knowledge building process that could be utilized to create collaborative learning environments that promote practical knowledge acquisition. Based on this, a method of documentation that promotes practical knowledge acquisition was created and tested. Third, to support students in acquiring practical knowledge through structured documentation activities in a collaborative learning environment conducive to implementing the knowledge building approach. Observation of learning behavior and analysis of the learning artifacts of documentation helped to clarify the characteristics of the process of practical knowledge acquisition.

"Environment" in an education context was interpreted based on Bronfenbrenner's ecological system theory. The definition of "learning environment" was explored and advances in learning environments over time influenced by the development of learning theories were analyzed. The characteristics of environments conducive to collaborative learning and potential influence of informational technology were also explored. There are also a number of areas of concern, three of which are explored focusing on unsolved problems regarding practical knowledge building in education. Based on this, "Documentation approach" that engages learners in a series of writing activities, was created. Three experiments were conducted with students involved in documentation activities including "making knowledge map and dialogue," "making interpretations of program," and "making manuals." Two of the three experiments were conducted in both off-line and on-line collaborative environments and one was conducted in an international collaborative environment. The learning activities and learning artifacts were used to analyze both individual and collaborative learning processes as well as the relation between these two processes. The results of these experiments demonstrated the effectiveness of the documentation approach in equipping students for better knowledge building and practical application of the knowledge gained.

<Chapter 1 Introduction>
Research purposes, methodologies, and dissertation structure are briefly introduced.

<Chapter 2 Research issues on collaborative learning environment>

In this chapter, basic concepts related to the study of collaborative learning environments are explored, including case studies regarding the construction of collaborative learning environments with classroom, school, regional, and international scopes. Based on the literature research and the instructional practice in school education, this part summarized deficiencies of collaborative learning environments when attempted to be used for practical applications: first, practical applications are often "exercises" that are often well-structured; secondly, the process of collaborative learning lacks visibility of the social dynamics of the work leading up to the completion of a task; third, student-driven learning is often in a pre-planned or unrestricted way.

<Chapter 3 Documentation approach for knowledge building in collaborative learning environment>

The essential elements of the documentation approach for knowledge building in collaborative learning environments are analyzed. There is a lack of agreement on the meaning of the term "knowledge building" so this chapter starts with a literature review of research and practices related to knowledge building. The review concludes the most important features of knowledge building are "creative knowledge work," "continuous incorporation of collaborative and individual learning," and "student-driven practical activities." In research by Marlene Scardamalia and Carl Bereiter, writing activities were proven effective for building knowledge in an educational context.

In order to promote practical knowledge building, this research proposed a "Documentation approach" that engages students in translating details of knowledge and personal understanding into written texts. To make easily understandable documentation, students needed to first gain a good understanding of learning contents themselves by doing extensive reviews and practical application experience. Individual documentation work incorporates ideas and feedback from other members producing higher quality collaborative documentation that also makes students' knowledge building processes through all phases of project work visible to teachers while also producing an extensive record of learning activities. The documentation can be used as a reference of needs and difficulties in student-driven learning and can be used by teachers to provide support in real time.

<Chapter 4 HyperMirror-mediated collaborative learning environments for documentation using concept maps and dialogues in foreign language learning>

Considering textbook dialogue exercises aren't always effective in preparation for real communication with native speakers, this chapter presents a series of documentation work with students learning a foreign language. It is not always easy to find native speakers to get adequate practice in the classroom so this study built a collaborative distance-learning environment for foreign language learners and native speakers. In order to provide a higher sense of presence with the remote video conferencing system, the environment used in our experiment was based on the HyperMirror (HM) video conferencing system which displays all participants in a single shared space rather than the disconnected separate windows of traditional videoconferencing, allowing students to communicate with each other as if they were standing side by side in the same room.

Japanese honorific expressions were chosen as the learning content due to its importance and difficulty for both foreign Japanese learners (Chinese students in this study) as well as Japanese native speakers. The Japanese students and the Chinese students formed virtual teams via the HyperMirror (HM) system and engaged in collaboratively producing a dialogue set in a Japanese company context in which team members brainstormed necessary roles for their stories and then acted out the roles. Before and after collaborative dialogue construction and role-play, students visualized the knowledge structure on Japanese Honorifics expression by drawing knowledge maps. Two separate coding schemes were used to analyze students' pre-mapping and post-mapping work and the discussions of collaborative dialogue making recorded on videotapes.

Experimental results demonstrated the effectiveness of our combination of collaborative language learning and the HM system with the foreign language learners. Based on analysis of these results, it was concluded that the process of collaborative documentation of dialogue creation with native speakers played a part in helping foreign language learners achieve practical application of grammar and vocabulary. The individual documentation of pre and post knowledge maps provided insight into the learning processes of students. The collaborative documentation of student-driven dialogue creation to be observed from start to finish. Collaboration with native speakers provided not only a practical application of the foreign language but also contributed to cross-cultural understanding between participants. In addition, the HyperMirror system provided learners with an engaging experience of communicating and interacting with native speakers side by side. Learners indicated they were better prepared for communicating with Japanese people than their peers who have never spoken with a native Japanese speaker: One student reported that her experiences in this project were instrumental in deciding to study abroad in an exchange program. Another student reported that communicating with Japanese students made her realize that outputting knowledge in the memory is rather difficult, but it is rewarding.

<Chapter 5 Collaborative learning environment for documentation of program commenting in programming learning>

In this chapter, a series of documentation work was designed to engage students in learning computer programming for practical application. The experiment was conducted with a class composed of 11 third-year undergraduate students studying Educational Technology preparing for a course assignment of "developing a digital textbook for undergraduate students" using HTML, CSS and JavaScript. A collaborative documentation platform was developed to give students simultaneous access to a shared online program commenting environment

and to support students learning programming. The functions of the documentation platform included a real-time code-editing interface with simultaneous access and automatic error detection, a shared database of programs documentation, and the recording of learning experiences, social dynamics and problems encountered. Students were able to program and do comment work together in real time and to invite others to view, check, and comment on their files.

Through analysis of the data gathered from students' personal and collaborative documentation work, insight can be gained into students' learning processes. The documentation work leading up to the artifact creation demonstrated the students' improvement of their understanding of programming, especially in their collaborative work. The comparison between different editions showed how collaborative program commenting work could be useful in improving knowledge building and students' engagement in knowledge building activities. Collaborative comment creation helped students develop better understanding of programs. Documentation works collected in different phases of the learning process revealed individual and collaborative learning processes and allowed them to be analyzed separately. Continuous support ensured student-driven comment creation work went smoothly. During their collaborative documentation work, sharing and discussing documentation of program comments contributed to reciprocal teaching and better understanding. In addition, students' feedback collected from the questionnaires confirmed data collected from platform: students commented that the platform's simultaneous display of coding windows and output windows was helpful for novices.

<Chapter 6 Collaborative learning environment for documentation of HyperMirror system>

In this chapter, a collaborative documentation environment with an authentic context under the partnership with a secondary school was explored. Students were engaged in a series of individual and collaborative documentation activities culminating in the production of a beginner-oriented user manual and a set of supplementary documents in the form of extensive record keeping recording of students' experiences, discussions, and problems encountered. The collaborative documentation documents serving as learning process recordings were monitored and tracked using an online collaborative documentation platform that allowed students to share their work and work together online in real time.

Analysis of the completion of learning objectives categorized according to Bloom's Taxonomy allowed the learning process used by students during documentation activities leading up to project completion to be seen. The collaborative nature helped to expose student learning during the course of the project (whereas a lot of the supplementary documents created might only exist in students' minds if the project work was done individually). By classifying learning objectives for construction and use of the HM system using Bloom's Taxonomy theory, it is able to organize data from student-created collaborative documents and analyze the achievement of these learning objectives during the students' learning processes. Compiling practical knowledge and experience into documentation written at an appropriate level for the manual's target audience helped students develop a better understanding of principle knowledge of the HM system. Supplementary documentation such as problem notes highlights support needs for learning difficulties during student-driven learning. The documentation process revealed comprehension gaps that may have been overlooked by a traditional approach with students' comprehension only being tested by exercises that could be completed simply by memorizing procedures. Usage of learning objectives could be used to organize and analyze data collected from the documentation process. The HM system is very complicated and it may have been difficult if not impossible for a single student to create a usable manual in such a short period of time, but the group of students in the study worked together, supplemented each other's learning and helped to discover and resolve issues without outside intervention.

<Chapter 7 Summary>

This research identified conditions that are necessary for collaborative learning environments to be used for practical applications of knowledge. Based on this, a "documentation approach" was developed to promote practical knowledge building and application in collaborative learning environments. Three experimental research projects were conducted to test this documentation approach. The documentation work proved to be useful in developing a better understanding of subject matter by requiring students to synthesize practical knowledge into written explanations that were easily understandable by a target audience besides their teacher while allowing teachers to visually observe the students' learning processes through all phases of project work and have a permanent record that could be referred to later. The research in this study showed positive results using the documentation approach, but further testing with more students and a greater variety of subjects are necessary in the future.

論文審査の結果の要旨及び担当者

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論文審査の結果の要旨

　本研究では、情報技術を活用した協同学習環境をベースとする問題解決型の教育実践に関して、ドキュメンテーション・アプローチを提唱し、その意義や効果を検証している。

　問題解決型学習では、その目的が特定の問題解決におかれるため、提案書や調査結果のようなレポート、具体的な作品などの制作物が生み出される。さらに、ワークシートや会議録、企画書など、学習過程に関わるさまざまな資料（ポートフォリオ）は、授業者にとって評価資料として有用であるだけでなく、学習者自身に振り返りを促し、より一般化した知識を生成するための道具として機能することが期待される。しかし、ひとたび教育方法が形式化してしまうと、制作物やポートフォリオは教育のためのものになってしまう。制作物は、教育の外側の具体的な問題と結び付けられ、ポートフォリオは個々の学習と結び付けられる必要がある。この要点を常に満たすような実践デザインとして、筆者は、共に学ぶ同輩や教師あるいは将来の学習者を読み手として挿入するドキュメテーション・アプローチを提案している。

　論文の第1章は研究の背景や目的、第2章は基本概念の整理と関連する事例などの調査、第3章ではCarl Bereiterらの知識構築という概念を礎に、ドキュメンテーション・アプローチの定義と有用性を論じている。

　第4～6章では、筆者がデザインした教育実践の事例とその評価が述べられる。第4章は、中国の学生が日本語の敬語を学ぶ場面で、「超鏡」という遠隔映像対話環境を通して、日中の大学生が協同で「知識地図」と名付けられた道具を用いて概念整理を行った実践である。第5章は、大学生がプログラミングを学ぶ際に、グループでのコードの共有と相互コメントが可能な電子環境を利用した実践である。第6章は、大学生が「超鏡」構築マニュアルを協同で作成しつつ、自らも知識を習得するという実践である。

　第6章のマニュアル開発では、遠隔学習で「超鏡」を利用する高校教師に向けて、知識を再構築するプロセスを実現しており、社会実践と学習過程が結びつけられている。また、研究全体で実践環境を周到に準備、データを丁寧に分析している点も評価できる。例えば、第4章では日本語と中国語の入り交じる会話分析を詳細に行っており、第5章では共同研究者と共に、グループで協同してプログラミングのできるオンライン環境の構築や映像コンテンツ教材を開発しており、実用上の価値も認められる。

　ドキュメンテーション・アプローチの有用性や課題を解明するには、更なる実践の積み重ねが必要と思われるが、本論文はその可能性を十分に論じていると評価できる。

　以上により、本論文は博士（人間科学）の学位授与にふさわしいと判定した。