

CHALLENGES UNIVERSITY STUDENTS FACE WHEN INTEGRATING NEW ICT TOOLS INTO THEIR LEARNING: AN EXPLORATORY STUDY OF A SOCIAL ANNOTATION TOOL

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Abstract: *To facilitate students' learning, teachers are keen to try out various ICT tools, recommend those they find useful to their classes, and even tailor-make tools for their classrooms with the assistance of engineers. However, students are not always eager to voluntarily apply these tools to their assignments. This paper reports on findings from a study that explored the introduction of a commercial social annotation application, Diigo, to university students enrolled in three different courses. All participating students were given a two-hour, in-class, face-to-face tutorial at the beginning of the semester. Diigo was expected to facilitate students' collaboration in collecting, sharing, analysing, and elaborating data while engaged in a group inquiry learning assignment. Seventeen students were invited to participate in individual interviews. Qualitative content analysis of transcripts was conducted to examine the challenges students faced when they decided to incorporate new technology into their studies. Findings indicate that although Diigo is helpful for data collection and sharing among students, students prefer Google Drive, an online file storage and synchronization service, for data analysis and elaboration. Interviewees pointed to the usability of the ICT tool, their motivation as students, peer influence, and the arrangement of the face-to-face tutorial as challenges associated with integrating the ICT tool. We argue that addressing these four areas of student concern is pivotal to the cultivation of a conducive atmosphere that encourages students to try out and integrate new ICT tools into their learning.*

Keywords: collaborative inquiry learning, higher education, ICT, social annotation

Introduction

Over the past decade, scholars have examined the challenges and effectiveness of student-centred approaches in enhancing the learning experiences of Asian students (Hallinger & Lu, 2011; Kember, 2000). It is anticipated that student-centred learning that prioritizes students' interests can help students achieve better learning outcomes (Hallinger & Bryant, 2013; Jones, 2007; Wright, 2011). Student-centred approaches, such as conducting inquiry-based learning and collaborative learning activities, encourage students to explore, acquire, and construct knowledge by themselves, as well as to reflect on and self-regulate their individual learning processes. Information and communication technology (ICT) has contributed to the important shift toward

student-centred learning by helping to scaffold students' exploration and management of knowledge while engaged in collaborative learning and inquiry-based learning (Henderson, Selwyn, & Aston, 2017). ICT also helps develop students' autonomy and independence by providing a virtual learning space that enhances students' learning experiences throughout the learning process (Aguti, Walters, & Wills, 2014). For example, at the beginning of a course, an instructor may illustrate different real-world situations via multimedia applications instead of lifeless verbal descriptions. Colourful photos and online videos help students develop a clearer picture of the situation. At the same time, students can make use of ICT to intensify group collaboration and facilitate

group projects. For example, Instant Messenger (IM) can help develop communication, and platforms like *Google Drive* can improve collaboration through on-line co-authoring in group-based projects.

Within higher education institutions in Hong Kong, instructors are eager to introduce new ICT tools to facilitate student-centred learning. However, these instructors find that when a new ICT tool is introduced in a voluntary adoption setting, students show little motivation to try out the new technology. This low willingness to incorporate the technology into their learning limits students' opportunities to learn with ICT (Lai, Wang, & Lei, 2012).

Literature Review

Collaborative Inquiry Learning

Collaborative inquiry learning (CIL) is a student-centred learning pedagogy (McLoughlin & Lee, 2007; Woolf, 2010) that has been described as a new and promising educational paradigm in contemporary higher education (Cober, Tan, Slotta, So, & Könings, 2015). CIL involves the integration of two learning methodologies: (a) collaborative learning and (b) inquiry-based learning (Bell, Urhahne, Schanze, & Ploetzner, 2010; Saab, van Joolingen, & van Hout-Wolters, 2007). Collaborative learning encourages students to interact with groupmates as they co-study through learning tasks (Dillenbourg, 1999). Inquiry-based learning requires students to identify investigation questions, conduct data collection, engage in data analysis and interpretation, and finally elaborate findings into conclusions that answer their investigation questions (Bell et al., 2010). In both methods, the instructor functions as a facilitator who provides guidance and advice in order to scaffold students' learning throughout the collaboration and inquiry process (Banchi & Bell, 2008; Rezba,

Auldridge, & Rhea, 1998).

By incorporating the advantages of the two methods above, collaborative inquiry learning provides valuable opportunities to students, especially university students, to study as groups and investigate their inquiry question(s) through self-exploration and collaboration. In this learning method, students usually work in groups of three to five to determine their inquiry question(s) via discussion, then decide how they will collect and share information gathered from different sources. Students work collaboratively with the shared information as they analyse, interpret, elaborate, and debate the data and respond to their inquiry question(s). Throughout this process, each student is assumed to contribute his/her own resources, knowledge, and skills to the group in order to complete the learning tasks, which can diminish individual discrepancies often associated with independent inquiry-based learning (Trentin, 2009).

Social Annotation Tool

In the Web 2.0 era, web users are no-longer passive receivers of information. They can be content creators and contributors who are empowered to comment as well as interact and discuss with different users on the Web (O'Reilly & Battelle, 2009; O'Reilly, 2005). According to Mejías (2005) (as cited in McLoughlin & Lee, 2007, p. 666), social annotation tools can be categorized as distributed classification systems, or "folksonomies." Folksonomies are tools that allow users to assign multiple tag-words to any information resource. Users can rediscover all resources attached to a specific tag-word(s) (Peters, 2009). These tools are among the key applications and services of the Web 2.0 era. Estellés, Del Moral, and González (2010) introduced a number of existing social bookmarking and annotation tools which cater to various kinds of information and user needs. *Diigo*

was analysed in detail for its major functions for teamwork and applications for learning and research. Based on the comparison with other social bookmarking and annotation systems, *Diigo* was chosen in this study because it is used widely in academia to support collaborative inquiry learning (Gao, 2013; Huang, Shen, & Chang, 2011; Li, Pow, & Cheung, 2015; Lu & Deng, 2012). *Diigo* is also well developed for collaborative work with text-based content on the Internet (Estellés et al., 2010; Pytash, Annetta, & Ferdig, 2016).

Diigo is a commercial social annotation tool that describes itself as "... a multi-tool for personal knowledge management" (*Diigo*, 2017) that aims to improve users' workflow and productivity. It was developed in 2016 and is managed by *Diigo Inc.* The tool not only allows users to bookmark and categorize webpages as normal web browsers are able to do during web surfing and information searching but it also allows users to highlight, comment, share, and reply to web-based text content and PDFs for individual and group use on any computer with a web browser and Internet connection. Furthermore, it can archive the webpages highlighted by users and saved in *Diigo's* server so that the webpages can be retrieved even if the original webpage has been deleted (Blake & Morse, 2016; *Diigo*, 2016; McTighe & March, 2015; Millen, Feinberg, & Kerr, 2005; Padoa, Schneider, De Souza, & Medeiros, 2015).

Some educational scholars have found that this product is able to facilitate higher levels of cognitive and meta-cognitive activities among university students through group sharing and discussions with the information collected (Estellés et al., 2010; Johnson, Archibald, & Tenenbaum, 2010; Li, Pow, & Cheung, 2015; Yang, Yu, & Sun, 2013). As suggested by Castek, Beach, Cotanch, and Scott (2014), it is also suitable for middle school students to conduct collaborative annotation which assists their close reading

of science texts.

Our study focused on undergraduates since these students are often flooded with large amounts of information even when completing a single assignment (Maybee, 2006). When students work on individual or group assignments, they can be overwhelmed by the vast amount of information available from a variety of sources, such as webpages, books, and journal papers. As such, they might need assistance to organize this information. In light of this, the social annotation tool seems to be an appropriate solution to help students organize and process information pertinent to their collaborative inquiry learning assignments.

Since the first generation of the social annotation tools was applied in education (e.g., *Hy-Lighter*), several studies have evaluated their effectiveness and examined students' perceptions of using those tools (Johnson et al., 2010; Razon, Mendenhall, Yesiltas, Johnson, & Tenenbaum, 2012; Razon, Turner, Johnson, Aarsal, & Tenenbaum, 2012). A number of researchers have focused on the recent well-developed product, *Diigo*, and, in particular students' collaboration when using the application (Curcher, 2011; Gao, 2013; Li, Pow, & Cheung, 2015). Im and Dennen (2013) found that students within a *Diigo* group contribute differently, with some being classified as web link contributors and some as commenters. Web link contributors are those who contribute more bookmarks than comments to their group. Commenters are those who commented more frequently than they bookmarked. McTighe and March (2015) suggest that *Diigo* would work better when students and teachers work and collaborate in the same group. The authors also showcased how teachers share information with all students through *Diigo* to foster discussions, comments, and evaluation in a short period of time.

Research Objectives and Implications

In order to enhance students' learning experiences, some instructors are keen to test new educational applications and introduce the most useful ones to students. Some have even worked in cooperation with engineers to tailor software or applications that cater to students with different learning needs. However, when instructors introduce new ICT tools aimed at facilitating students' learning in a university context, not many students are willing to integrate the recommended technologies into their learning, particularly when the implementation is voluntary (Lai et al., 2012).

For this study, selected students from three courses were interviewed to learn about their perceptions about their learning processes and understand their experiences of being introduced to a new ICT tool. The following two research questions guided our study:

1. How and why do students incorporate new ICT tools in their learning process?
2. What are the challenges and concerns university students have encountered with the new ICT tools in their learning process?

Based on the findings of this study, educators and/or researchers should further investigate the benefits and challenges of integrating computer-supported educational tools in collaborative inquiry learning in a voluntary adoption setting. We provide recommendations intended to encourage students to make use of new ICT tools which are designed to assist their learning.

Research Design and Methodology

Our research study was a one-semester action research project at a university in Hong Kong and ran from January to June 2015. Students in two undergraduate-level courses (Course G, "CG" with 3 sub-

sections & Course E, "CE") hosted by the Department of Education Studies and another same level course (Course S, "CS", with 4 sub-sections) hosted by the Department of Sociology were invited to participate in data collection. These courses were chosen because they included collaborative inquiry learning assignment(s) (CILA). In total, there were 107 students studying in CG; 38 in CE; and 50 in CS (N=195). After eliminating students who withdrew from the courses and students who did not provide consent agreements, valid data for analysis included response from 180 students (n=180).

The Design of the *Diigo* Tutorial

At the beginning of the second semester (January, 2015), the commercial social bookmarking and annotation application, *Diigo*, was introduced to students of the three courses through a two-hour, in-class, face-to-face tutorial (total teaching hours of each course were: 39 hours for CG; 27 hours for CE; and 39 hours for CS). Researchers purchased the full function professional accounts for each student in the three courses, and students could use all functions provided by *Diigo*. In this tutorial, researchers aimed to fulfil three objectives: (a) introducing the basic functions of *Diigo*, (b) introducing the advantages of using *Diigo*, and (c) helping each group to setup a group folder for their future CILA collaboration.

In the first 45 minutes, researchers outlined the basic functions of *Diigo*, which included bookmarking a webpage, highlighting web content, commenting on the highlighted web content, sharing resources in a group folder and replying to their groupmates in the group folder. After that, a 45-minute in-class activity was assigned to the students which allowed them to have hands-on experience with *Diigo*. In the in-class activity, students were guided to install *Diigo*'s web browser extension, and then

they were asked to bookmark a webpage and share their bookmark with their groupmates in the group folder. Subsequently, students were required to browse and reply to the shared bookmarks in their group folder. In addition to the in-class tutorial, a set of digital (PDF) user manuals, written by the researchers, was sent to the students by their instructors as supplementary support after class.

The Requirements of the CILA

Immediately following the tutorial session, instructors introduced the details and requirements of the CILA. As part of the course, students were asked to spend 4 to 10 weeks to complete their CILA (10 weeks for CG; 4 weeks for CE; 10 weeks for CS). In CG and CS, students could voluntarily choose the ICT tool for their group project, while CE assigned collaborative tasks on *Diigo*. Students were free to decide mediums for communication and collaboration with groupmates. If students decided not to integrate *Diigo* in their CILA, they were asked to provide evidence that demonstrated their collaboration, as “collaboration” was one of the assessment requirements (about 5% to 10% of the whole assignment). Collaboration was graded according to how students actively contributed to the group and the fairness of the workload allocation in their CILA.

Purposeful Sampling on Interviewees According to Students’ Usage on *Diigo*

To answer the research questions, a qualitative research approach was adopted to explore how and why students integrated *Diigo* in their learning process and to identify challenges and concerns that arose when they integrated *Diigo* into their CILA. When students submitted their CILA at the end of the semester (between late April and early May, 2015), researchers calculated the frequency of students’ usage of *Diigo* for their CILA. Researchers invited students to

attend an individual interview based on the frequency of their usage of *Diigo*. Frequency was determined based on the number of students’ bookmarking, highlighting, commenting and replying behaviours. By counting the interactions in the same CILA group, researchers identified the most active and least active groups in each course. All students from the chosen groups were invited through email to participate in the interviews, but only a few students replied and attended the interview. To increase interview participation, researchers decided to invite the second most active and the second least active groups in each course to participate in the interview. All group members were invited to participate in individual interviews in order to triangulate the data and gain a larger picture of the process.

Students were invited to participate in a one-hour individual semi-structured interview between April and June 2015 after they submitted their CILA. There are two reasons for conducting a one-hour individual semi-structured interview. First, this format provided interviewees with plenty of time to describe their CILA. Each interviewee was asked the same questions to understand the whole working process within the group. This also helped researchers to understand students’ perceptions of using ICT tools in this CILA. Researchers were also able to ask follow-up questions to further explore the challenges and concerns students encountered while applying *Diigo* in the CILA. Second, the interview format helped students feel comfortable discussing their experiences. According to Gill, Stewart, Treasure, and Chadwick (2008), a setting in which students are alone and not in the presence of groupmates increases students’ comfort level and eagerness to share their perceptions with researchers.

In the first section of the interview, students were asked to list software and applications that had been applied in their CILA. It

followed with questions about the rationale for applying those technologies and their effectiveness. In the second section, reasons for integrating or not integrating the new ICT tool *Diigo* in the CILA project were solicited to tease out their perceptions of the social bookmarking and annotation tool.

All interviews were audio recorded with the consent of the interviewees. Interviews were then transcribed for analysis. Qualitative content analysis was adopted to code the interview transcripts and distinguish students' difficulties with and/or doubts about adopting *Diigo* in their CILA.

Findings and Discussion

In this study, there were 42 CILA groups in the three courses: 21 groups in CG; 8 groups in CE; and 13 groups in CS. Table 1 displays the calculated number of interactions between students on *Diigo* in

the three courses. Table 2 displays the number of interactions between students on *Diigo* in the invited CILA groups. Based on the purposeful sampling method described in the methodology section, 55 students in twelve groups (30 from CG; 14 from CE; and 11 from CS) were invited to take part in individual semi-structured interviews. In the first round of interviews, 1 out of 10 students from CG, 1 out of 9 students from CE, and 6 out of 8 students from CS participated in the interview. In the second round of interviews, 5 out of 20 students from CG, 2 out of 5 students from CE, and 2 out of 3 students from CS participated in the interview. In total, 17 out of 55 students attended the interview. The code for each interviewee included three parts (CX SX-A): CX indicated the course from which the interviewee came; SX indicated the code of the interviewees; and A/AI stood for the most active or least inactive group respectively.

Table 1
Number of Interactions Between Students on Diigo in the Three Courses

	Number of Interactions per Student on <i>Diigo</i>			
	Maximum interactions	Number of students who never used <i>Diigo</i>	M	SD
Course G (n=93)	65	71	3.03	10.08
Course E (n=38)	57	11	10.33	14.12
Course S (n=49)	181	15	25.64	41.05

Table 2

Number of Interactions Between Students on Diigo in the Invited CILA Groups

	Number of Interactions (Number of Group Members Interviewed)	
	Most Active Groups	Least Active Groups
Course G	Group 2G: 72 (0 out of 5) Group 3F ^{**} : 15 (2 out of 6)	Group 2F: 7 (1 out of 5) Group 1A ^{**} : 0 (0 out of 5) Group 3A ^{**} : 0 (3 out of 4) Group 2A ^{**} : 1 (0 out of 5) Group 7: 8 (1 out of 4)
Course E [*]	Group 6: 64 (0 out of 5) Group 5 ^{**} : 79 (2 out of 5)	
Course S	Group 6: 275 (4 out of 4)	Group 1: 0 (2 out of 4) Group 13 ^{**} : 9 (2 out of 3)
Total number of interviewees:		17 out of 55

Note.

^{*}Students in this course declined the interview invitation. Researchers decided not to invite the second least active group.

^{**}Group invited in the second round of interviews

The interview data shows two advantages of using *Diigo*: (a) facilitating data collection and data sharing among groupmates, and (b) transferring of highlighted notes to *Google Drive*, an online file storage and synchronization service, for further group analysis and elaboration. However, as students were making decisions about whether to integrate the new ICT tools introduced by instructors, they encountered four challenges: (a) low usability, (b) low motivation, (c) peer influence, and (d) limited tutorial training. These challenges discouraged students from adopting *Diigo* to assist their collaborative work in their CILA.

Advantages

Facilitating Data Collection and Data Sharing. Some interviewees from the most active groups stated that they did try to use *Diigo* for their data collection as a response to their instructors' recommendation. At the early stage of their CILA, they uploaded, highlighted and shared information collected from different sources with *Diigo*. Once a member highlighted and/or commented on a web-based text or PDF contents, the highlights of web and PDF contents were saved in *Diigo*. Interviewees

CSS5-A and CSS7-A expressed that their groupmates could easily grasp the important points through the highlighted sentences.

Transferring Information to Google Drive for Data Analysis and Elaboration. Some interviewees appreciate *Diigo's* transfer function which allows migration of their highlights and notes to *Google Drive* for further discussions, data analysis, and elaboration. Interviewee CSS6-A stated that they completed data analysis directly on the highlighted contents. Then, they simply created a *Google Drive* folder (*Google Docs*) in a face-to-face meeting and put their research questions in it. After that, they constructed the structure of the writing and divided the assignment into a few parts in the meeting that enabled them to work on their own part after the meeting. Later, they referred to the information on *Diigo* and put information in *Google Drive* according to their needs. Another interviewee expressed the importance of the face-to-face meeting before transferring information to *Google Drive*. This meeting allowed students to confirm the structure of the final text or presentation after they had conducted the background research on their CILA topic and after they had started working on their own parts in *Google Drive*.

Challenges

Low Usability. Low usability of *Diigo* is a key obstacle that discouraged interviewees from integrating this new ICT tool into their CILA. For example, CSS1-IA explained that she only experienced using *Diigo* during the tutorial. When she and her groupmates worked on their own, they were unsure about how to make use of *Diigo*. Because of this, she and her group were less willing to try new things and ultimately gave up using *Diigo*. Conversely, students who could manipulate the tool in a short period of time were less likely to give up quickly and more likely to continue using it. For example, a member from the most active group, CSS8-A, explained that she could follow the demonstration by the researchers and pick up most of the functions in the tutorial.

According to Bevan, Kirakowski, and Maissel (1991), the term *usability* is used to evaluate the ease of learning and using a software/application (App) and can be measured in terms of “mental effort” and “attitude of the users.” In this study, evaluation of the usability of a software/application focuses on three criteria, as noted by Nielsen (2012): (a) *learnability*, or how easily users accomplished basic tasks the first time when they were introduced to the software/Apps, (b) *efficiency*, or how quickly users learned to perform the tasks of the new software/Apps, and (c) *satisfaction*, or how pleasant it was for users to use the software/App.

In the case of using *Diigo*, user experiences were inconsistent with different digital devices. In this study, students had fully functioning professional *Diigo* accounts. Students were able to use all functions provided by *Diigo*, including: bookmarking, highlighting, annotating, and sharing web content with a web browser extension on their computers. However, they were only

allowed to read their annotations on smartphones and tablet computers. Although ubiquitous learning in the information age expects that many students would work with their mobile devices, the applications may not be fully accessible on mobile devices. For example, CGS23-IA explained that one of the major challenges she faced was the accessibility of the mobile version of *Diigo*. She stated that although *Diigo* has a mobile version, it includes less than 70% of the basic functions of the web-based version. This was not convenient for the students who preferred to work with their mobile devices. The student shifted to use *Google Drive*, claiming that most of the students could not get used to the software and found it inconvenient because it required access through a specific website with a separate login. CGS3-A also expressed that it would be great if the mobile App of *Diigo* could help her to bookmark and search the annotation. These functions would have allowed CGS3-A to perform all functions on her mobile device.

Apart from the availability of functions on different devices, users are required to install an extension on their web browser on their desktop computers before their initial use of *Diigo*, a requirement some interviewees found troublesome. Although it is a simple installation via *Google Web Store*, CGS3-IA and CSS9-IA found it inconvenient to install *Diigo* on the computers in the computer laboratory. They also needed to install it again on each of their own computers after the lesson. The inconvenience of using *Diigo* on multiple computers is that it takes about 10 minutes to download and install the extension on every new computer even if students only want to highlight one sentence of web content. However, students from the most active group did not express any inconvenience with the extension installation.

In addition, students need to go through

several steps in order to update their own and collaborators' annotations. When students want to read the most updated annotations of a webpage or a PDF, they need to visit that webpage or PDF through the URL bookmarked on *Diigo*'s library. By clicking the *Diigo* web extension, the web extension recalls all the annotations that were previously made. Users are now able to read the most updated annotations and can highlight, annotate and comment on their own. Overall, most of the interviewees criticized the tool's low usability and explained that using *Diigo* presented great barriers for them in their group work.

Low Motivation. Low motivation is another significant challenge when students decide to integrate a new ICT tool. Students were reluctant or even refused to use the ICT tool recommended in their studies. The reasons for interviewees' low motivation can be summarized as follows: (a) students were already satisfied with the existing ICT tools they were using and saw no need to learn a new tool, (b) students were hesitant to try out new technologies they were not familiar with, and (c) students were not willing to spend extra time exploring new ICT tools for their studies after the tutorial or lesson.

Interviews revealed that interviewees usually used *Instant Messenger* (IM) and social networking sites (SNS) to communicate and co-operate with group members on projects. In the Hong Kong context, students particularly favour *WhatsApp* and *Facebook Groups*, and work together on a collaborative platform, *Google Drive*, to share resources and co-author in groups. Almost all of our informants were already satisfied with these applications and did not see any need for substitutes. As CGS16-IA said, "I think *Google Drive* and *Diigo* are quite similar. If I have the choice to use *Google Drive*, why I should use *Diigo*? Both of them are platforms to work for group projects with others." Furthermore, both students from the most

active and least active group expressed that they were hesitant to try out unfamiliar software or applications because they are out of their comfort zone. Comments included: "I seldom use web applications (Apps) for doing assignments. I use *Microsoft Word*. I type with it and then send (the writing) out" (CGS21-IA); "I prefer using software I am using currently" (CSS5-A), and "I prefer using the software all groupmates are satisfied [with], such as *Google Drive*, instead of learning a new one that we may find challenges [with]." (CSS1-IA)

Some students explained that they were not willing to invest extra effort and time in exploring new ICT tools even though they recognized the benefits of enhancing their learning experiences. One student explained their difficulty using *Diigo* while working on their initial group topic, "We did try using *Diigo* to archive resources. After attempting to use *Diigo* for a short period of time, we still could not get used to this software. We foresee that this might cost lots of our time" (CGS11-IA). When CGS11-IA's collaborative group changed their assignment topic, they gave up using *Diigo* at the same time. Similarly, other students were concerned that their effort would not be reflected on their assessment if they voluntarily used the new ICT tools. CSS6-A, however, was motivated to learn new ICT tools because she was curious about the technologies and also recognized that future jobs might require candidates to know how to use unfamiliar software in a short period of time.

Peer Influence. Peer influence is a key factor affecting whether a group of students considers introducing new ICT tools into their CILA. An interviewee from the least active group shared that most of her groupmates were still in doubt after the tutorial. "By the time we completed the in-class task after the tutorial, we felt that this software was really complicated" (CGS11-

IA). Students also estimated that they needed to spend a couple of hours learning about *Diigo* before they could use it in their CILA. Although CGS11-IA was passionate about using new tools and tried to use *Diigo* in the afternoon after the tutorial, she was only comfortable using the tool if all members of the group were familiar with it. Because her groupmates were still hesitant after trying *Diigo* and could not get used to this new technology, the group decided to give up *Diigo* in this CILA and CGS11-A decided not to pursue using the tool.

In general, the main reasons why students resisted integrating the new ICT tool was because students felt unfamiliar with the tool and were concerned about spending extra time and effort learning a new tool. However, as CSS5-A explained, these two reasons can be offset by peer influence, as students will adopt a new ICT tool if the software is introduced by their peers, and if the ICT tool is widely used in the community.

Limited Tutorial Training. A two-hour, face-to-face tutorial was held in all participating courses. This tutorial aimed to familiarize students with *Diigo*, which was a new ICT tool for them. In the tutorial, researchers demonstrated the basic functions of *Diigo*, such as bookmarking a website, highlighting web content, and commenting on the shared web content of their groups. After the demonstration, students were asked to practise these functions with their groupmates. A number of interviewees from the least active group complained that the tutorial was too packed. They were unable to pick up all basic functions introduced by the researchers in the tutorial. CSS1-IA suggested that a one-time tutorial on a new ICT tool was not enough and suggested that this arrangement did not provide opportunities to continuously practice, learn, and integrate all of the functions of *Diigo*. She mentioned that she needed at least five to six lessons for learning new software in

her secondary school.

Conclusion and Implications

In this study, researchers introduced a new ICT tool, *Diigo*, to students in three undergraduate courses. It was expected that *Diigo* could facilitate students' collaborative inquiry learning assignment (CILA). At the beginning of the semester, *Diigo* was introduced and demonstrated to students through a two-hour face-to-face tutorial before introducing the CILA in the three participating courses. Students were encouraged to integrate this ICT tool to assist collaboration in their CILA. Use of the tool was voluntary, although collaboration was part of the assessment criteria. *Diigo* was expected to assist students in data collection, data sharing, data analysis, and data elaboration. However, findings showed that most of the interviewees refused to use *Diigo* and few of them adopted the tool to facilitate their data analysis and evaluation.

To answer our research questions, researchers observed that university students mainly applied *Diigo* in the early stage of their CILA. Researchers also discovered four types of challenges students faced in their CILA. In the early stage of their CILA, students tried to use *Diigo* in their data collection, mainly for highlighting, commenting, and sharing information among the groupmates. However, students reported that they readily gave up using the new ICT tool once they ran into challenges. Students subsequently returned to using their favoured platform, *Google Drive*, to continue their work on data analysis and evaluation. Interviewees described that *Google Drive* was a form of ICT that was in their comfort zone as most of them had been using the tool since they began their studies at university. Also, they found *Google Drive* useful since each group member could monitor others' updates in real time.

From the interviews, students faced four challenges when they met a new ICT tool like *Diigo*. The four challenges were: (a) low usability, (b) low motivation, (c) peer influence, and (d) limited tutorial training. In what follows, we draw upon these challenges to provide recommendations for educators who wish to effectively introduce new ICT tools to their students.

Usability ICT Tools

Enhancing the usability of ICT tools is one way to encourage students to integrate a new ICT tool in their studies. When students recognise a new tool is complicated to use, they may revert back to using more familiar tools. In order to successfully introduce a user-friendly ICT tool to the students, instructors should choose, design, and test the tool carefully. A user-friendly software or application also should be accessed easily and effectively (ISO 9241-11, 1998). Other factors that also should be taken into consideration include: (a) the complexity of performing specific functions, (b) the similarity between the interface and different platforms, and (c) the preparation work required before using the software.

To evaluate the complexity of performing specific functions, instructors should test and evaluate the tool to determine whether students may find it difficult to use. When instructors want to introduce a new ICT tool to their students, they should first practice the functions of the ICT tool (software or App) that students are expected to use in their assignment. Instructors can estimate whether students can handle and use the new ICT tool. Furthermore, if instructors realise that the tool is too complicated for students, instructors should replace the tool with another one or decide not to introduce any tool at all. Moreover, when instructors have solid experience using a new ICT tool, they can more effectively guide their students in the use of the tool and its functions.

To examine the similarity of the interface on different platforms, instructors should try out the ICT tool on different platforms (i.e. *Windows* and *Mac OS* on computers, and *iOS* and *Android* on mobile devices). It is important to ensure the similarity of the user interface and user experience on different platforms so that students do not need to adjust their using habits when they switch between platforms.

To examine the preparation work before students can use the ICT tool on their devices, instructors should be aware of the complexity of the preparation work (such as installation) of the ICT tool on different devices. Students can be easily discouraged by the complicated set-up procedure, which can include installing once on each device or requiring pre-requested software and/or updates. In the new version of *Google Chrome* browser, newly installed extensions will be automatically synchronized on all computers logged in with the same *Google* account. Because of this, students do not need to install the same tool on each computer once they login with their *Google* account. This update can minimise the preparation work required to use the new ICT tool.

In conclusion, usability of an ICT tool is critical when students decide to integrate it into their learning. Instructors should consider the recommendations provided here when they introduce the tool or develop a new ICT tool for their students. When tools have increased usability, students are left with a good impression of the tool and are more likely to integrate it into their learning.

Students' Learning Motivation

Stimulating students' motivation to learn and use a new technology is challenging but crucial when integrating a new ICT tool. There are two possible ways to enhance

students' motivation to learn the new ICT tool: (a) describe the relationship between the new ICT tool and their learning and (b) describe how the new ICT tool can enhance their learning process compared with existing tools.

It is important to describe the relationship between the new tool and student learning. In this study, students could not see how the new tool could be used for their learning. In the interviews, few students mentioned how to integrate this tool into their CILA. Researchers also reflected that they seldom connected the advantages of *Diigo* with their CILA in the tutorial. Accordingly, students did not realise how the new ICT tool could be used for their CILA and failed to associate and mention how the new ICT tool could facilitate their management of information and diverse resources collected for their CILA. Without a sense of these connections, students were less motivated to learn and integrate new ICT tools into their CILA.

Instructors need to explain how the new tool can enhance their learning process, particularly when students are satisfied with similar existing tools. Students mentioned that they were satisfied with the ICT tools they previously were using for their learning, which is one of the major reasons students had a low motivation to learn and adopt *Diigo*. Furthermore, students believed that the new ICT tool was not a necessary or irreplaceable tool for their learning. For example, with *Google Drive*, not only did it fulfil most of the needs of students' CILA, but students learned to use the tool by themselves or from peers in high school. This made it very difficult to stimulate students' motivation to learn and adopt the new ICT tool.

To summarise, it is very important to clearly explain the benefits and demonstrate the functions of the new ICT tools to the students in order to help them realise the

possible advantages of learning and adopting the new tools. Instructors should not only demonstrate the functions of the new tool, but they should also emphasize the relationship between the new ICT tool and their learning to increase motivation to learn and use the tool.

Peer Influence

According to the interviewees, peer influence impacted whether they considered integrating a new ICT tool in their CILA. If one group member was in doubt of using the new tool, other members tended not to integrate the new ICT tool into their learning process. Therefore, instructors should prepare sufficient technical support or tutorial materials to support students to pick up the new ICT tool during and following the tutorial.

Previous literature suggests that a self-learning package should be prepared and provided to students to allow them to learn how to use the tools by themselves. A self-learning package may accommodate different students' needs, including fast and slow learners, by providing them with plenty of time to try out or attempt to learn how to use the new tool (Fitts & Posner, 1967). The self-learning package should contain a series of short videos or screen captures to learn the basic functions of the software or application. The short video or screen capture can include a step-by-step procedure on how to perform a particular function. Students may feel more comfortable learning the new tool when using the package. As more students learn and become familiar with the new tool, peer resistance to the new tool can be reduced.

Tutorial Training

In this study, we prepared a one-time two-hour tutorial for all participating students. This may not be the best tutorial arrangement for introducing a new ICT tool.

When instructors want to introduce a new ICT tool in their course, they may decide to divide the tutorial for the tool into multiple tutorial sessions. In the interviews, students from the least active group expressed that the two-hour tutorial did not provide sufficient time for them to learn the functions of the ICT tool. They also expressed that they missed how to use some important functions. To ensure all students understand how to use the functions, instructors may split the tutorial into two or three sessions together with in-class and after-class activities. This arrangement may have two possible advantages. First, students have time to revise the functions introduced between tutorials. Using *Diigo* as an example, in the first tutorial, students new ICT tool. Second, instructors should include tutorial tasks related to their assignment in the tutorial. The tutorial tasks should not only allow students to use the new tool, but also let the students prepare some preliminary works (e.g., search information related to the ideas on their inquiry question) for their assignment with the new tool. In the after-class activity of the first tutorial, instructors may encourage

learned hands-on how to bookmark a website, highlight web content, and comment on the highlighted web content through in-class activities. Before the second tutorial, students can be asked to explore their inquiry questions and put related information on *Diigo* as an after-class activity. With this arrangement, students have more time to learn and revise how to use the new ICT tool, even though students cannot catch up in the tutorial. In the second tutorial, instructors can introduce how to share annotations to a CILA group folder and comment on others' annotations. Because of this tutorial arrangement, two tutorials can be linked up to allow students to have longer exposure to the

students to explore information in those areas that may possibly become inquiry questions for their CILA. When students start to use the new tool in the early stages of their assignment, there will be more information accumulated in the new tool, increasing their success using the tool throughout the assignment.

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