Cover Page

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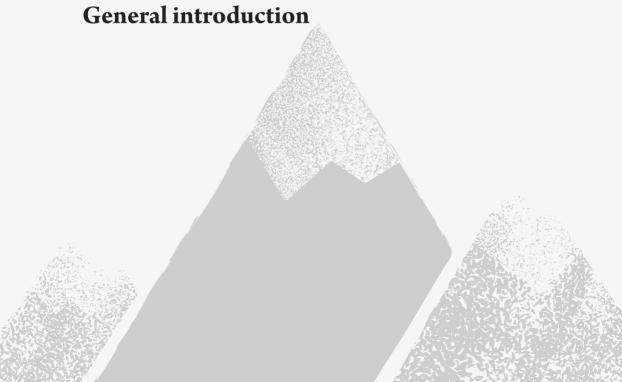**Title**: Online project-based higher education: student collaboration and outcomes
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Chapter

1

General introduction

1.1 Context of the study

The traditional, teacher-centered pedagogy still dominates classroom teaching in Chinese universities. With this teaching-learning style, teachers usually take the major responsibility for the transmission of knowledge to learners and therefore, decide what to learn and how to learn (Mascolo, 2009). This might deprive learners of the opportunity to actively participate in educational activities the way they want, which could lead to low learning motivation, engagement, and satisfaction (e.g. H.-K. Wu & Huang, 2007; Yin et al., 2016; H. Zhang et al., 2011). In contrast, student-centered education highlights learners' initiative (Mascolo, 2009) and their central status in the learning-teaching process (Nasri, 2019). From this view, teachers act as facilitators rather than the dominant leader of student learning (Goodyear & Dudley, 2015; Hancock et al., 2002; Rowley et al., 2018). Recent meta-analysis studies have reported that student-centered instruction benefits both students' cognitive achievement, namely content knowledge (Bernard et al., 2019) and soft skills, such as interpersonal skills and collaborative learning skills (Rukmini et al., 2018). Thus, recently, the Ministry of Education of the People's Republic of China released its first national standard on the teaching quality of higher education institutions, in which the principle of student-centered is highlighted (MOE, 2018). Following this national standard, educational reform is needed in order to transform the teaching and learning in the Chinese university from traditional, teacher-centered instruction to student active learning. One possible way to do so is to introduce and implement the pedagogy of project-based learning (PjBL) in the university curriculum. PjBL is considered an alternative to teacher-centered direct instruction in higher education (Chen & Yang, 2019). Through the creation of project artifacts, students are encouraged to test and achieve their ideas autonomously and eventually construct new knowledge. Therefore, in comparison to similar pedagogies (e.g. problem-based learning), PjBL is of more significance in higher education that values both hard skills, namely cognitive knowledge and professional skills (Vogler et al., 2018) and soft skills, such as critical thinking, collaboration, and innovative competence.

The current dissertation presents a review study and three empirical studies, focusing on the understanding of the state of the art of research about PjBL in higher education and the investigation of the relation between PjBL and student outcomes in the context of Chinese higher education. Insights into the design and the implementation of PjBL curricula and their potential impact on student learning are informative for a broad array of higher education teachers and educational advisors.

1.2 Conceptual framework

Three conceptual frameworks were adopted in the empirical studies presented in this dissertation. The framework of Project-based learning was used in all empirical studies in Chapters 3 to 5 as the whole dissertation focuses on student learning with the pedagogy of project-based learning. Self-Determination Theory was adopted in the study in Chapter 3, revealing students' motivation for project-based learning. The Community of Inquiry framework was used in the studies in Chapters 4 and 5 in order to understand students' presence during online collaborative project-based learning.

1.2.1 Project-based learning

Project-based learning (PjBL) refers to an active, student-centered instructional method that engages learners in knowledge acquisition, application, and construction by accomplishing meaningful projects and creating real-world artifacts (Brundiers & Wiek, 2013; Krajcik & Shin, 2014). The creation of artifacts is most important in the learning process, which distinguishes PjBL from other student-centered pedagogies, for example, problem-based learning (Blumenfeld et al., 1991; Helle et al., 2006). During PjBL, learners normally participate in a series of activities with peers in groups (Chen & Yang, 2019; Dado & Bodemer, 2017). Teachers usually act as facilitators and provide feedback and support for learners (Quintana & Quintana, 2020; Tseng et al., 2013). In addition, ICT tools are often integrated with PjBL to scaffold the

learning process (Chen & Yang, 2019; Krajcik & Shin, 2014). Many studies have shown that PjBL is positively related to various learning outcomes, such as students' content knowledge (e.g. Çelik et al., 2018; Torres et al., 2019), self-efficacy to the subject (e.g. Costa-Silva et al., 2018; Wu et al., 2018), hard skills and soft skills (e.g. Brassler & Dettmers, 2017; Vogler et al., 2018), and engagement (e.g. Cudney & Kanigolla, 2014; Fujimura, 2016). However, a few studies have reported that learners encountered difficulties during collaborative PjBL, such as interpersonal conflicts with group members (Dauletova, 2014), free-riding issues (Davenport, 2000), the problem of leadership and the division of labor (Lima et al., 2007), and the problem of time-consuming (Raycheva et al., 2017; K. Zhang et al., 2009). In addition, Chinese students might not be used to collaborative PjBL due to the competitive culture for better grades (K. Zhang et al., 2009) and the prevalence of teacher-centered and examination-oriented teaching methods (Gu, 2006; Leung et al., 2008). Thus, it is necessary to understand whether Chinese students are motivated for collaborative PjBL.

1.2.2 Self-Determination Theory

Self-Determination Theory (SDT; Deci & Ryan, 1985) is used to understand students' motivation for PjBL. Based on SDT, motivation can exist in specific activities at a specific time and therefore, is referred to as "situational motivation" (Deci & Ryan, 2010; Guay et al., 2000). Thus, SDT is suitable for exploring students' motivation in the PjBL activities in this dissertation as students participated in a specific project for a few weeks and collaboratively develop the final artifact. Three aspects of motivation can be structured based on SDT, namely intrinsic motivation, extrinsic motivation, and amotivation. Intrinsic motivation indicates students' doing of an activity due to their inherent interests and enjoyment. Extrinsic motivation refers to learners' conduction of an activity because of external outcomes. Amotivation describes the state that students lack an intention or willingness to engage in learning activities. These types of motivation play various roles in student learning outcomes (e.g. Balkis, 2018; Jeno et al., 2019; Liu et al., 2020).

1.2.3 Community of Inquiry framework

The Community of Inquiry (CoI) framework (Garrison et al., 2000; Garrison & Arbaugh, 2007) is adopted to understand both learning and teaching processes in online collaborative PjBL in this dissertation. This framework contains three essential components, including social presence, cognitive presence, and teaching presence. Social presence refers to online learners' ability to interact socially and emotionally with other participants and see them as "real" people in a community of inquiry through the means of communication used (Garrison et al., 2000) and consists of three components (Rourke et al., 2001): 1) affectiveness, 2) open communication, and 3) group cohesion. Cognitive presence is defined as the extent to which "learners are able to construct and confirm meaning through sustained reflection and discourse in a critical community of inquiry" (Garrison et al., 2001, p 11) and contains four levels (Garrison & Arbaugh, 2007): 1) triggering event, 2) exploration, 3) integration, and 4) resolution. Teaching presence involves three aspects, including the design and organization, facilitation, and direct instruction of teaching practice (T. Anderson et al., 2001). It usually plays a central role in an online community of inquiry (Garrison, Cleveland-Innes, et al., 2010) and influences social presence and cognitive presence (Cleveland-Innes et al., 2019; Garrison et al., 2000). These three presences together contribute to the realization of meaningful educational learning outcomes (Arbaugh, 2008; Armellini & De Stefani, 2016; Garrison & Anderson, 2003).

1.3 Overview of the dissertation

Studies presented in this dissertation have two main research aims. The first main research aim is to understand the state of the art of research about PjBL in higher education (Chapter 2). The second main research aim is to investigate the potential relations between various learning outcomes in PjBL implemented in the online environment (Chapters 3 to 5). The second main research aim is achieved on the basis of the understanding of existing studies

and the limitations of previous studies that were found in the study in Chapter 2. All courses implemented in studies presented in this dissertation were online and the teaching and learning processes were also conducted online. Table 1.1 presents an overview of the key elements of the four studies included in Chapters 2 to 5.

In the review study in **Chapter 2**, a total of 450 articles were found and 76 articles were selected for review. A clustering matrix was set up to categorize the research design, learning outcomes, measurement instruments, findings, and limitations of the studies reviewed in order to answer the research questions. The results found some limitations of previous studies that are worth being further addressed, such as the insufficient investigation of students' motivation and learning strategies for PjBL and student learning processes in PjBL, and their relation with both cognitive and affective learning outcomes, especially in the online environment. These constitute the basic idea of the studies in Chapters 3 and 4.

More specifically, the study in **Chapter 3** investigated the relation between college students' motivation for, learning strategies used in, and evaluations of online collaborative PjBL. An online course was implemented, during which students watched instructional videos for basic content knowledge, attended online lectures, and participated in a project-based activity in small groups and created a project artifact. During the entire process of the project, each group of students communicated and discussed the project in their own WeChat groups. Survey data were collected from 81 students from 25 groups and a partial least squares analysis was adopted to answer the research questions.

In **Chapter 4**, a study was conducted based on the same course implemented in Chapter 3. The aim of this study was to understand students' presence in asynchronous online discussions during collaborative PjBL and how it might impact their academic performance. Based on the CoI framework, transcripts of 24 groups of students' online discourse were collected and analyzed regarding social and cognitive presences via an adapted coding scheme. Moreover, the quality of students' artifacts was evaluated by a grading rubric developed by the researchers. Descriptive analyses were used to characterize the level of students'

presence and stepwise multiple regression analyses were adopted to reveal the relation between students' presence and achievement.

The study in **Chapter 5** also adopted the CoI framework as used in Chapter 4 and focused on the role of teachers and how it was related to students' evaluations of online PjBL. During an online project-based course, students attended online lectures and participated in two activities and developed two artifacts in small groups on WeChat. Survey data were collected from 38 and 41 students after each activity, respectively. A partial least squares analysis was adopted to reveal both direct and indirect impact of teaching presence on students' evaluations of online PjBL in different course stages.

Chapter 6 provides a summary and general discussion of the results of this dissertation. The last chapter, **Chapter 7**, presents some reflections of the dissertation author after finishing this project.

Table 1.1. *Overview of the four studies presented in this dissertation*

Chapter	Article type	Research questions	Context	Participants	Data source and collection	Data analysis	Relation with other chapters
Two	Review study	1. What student outcomes of PjBL are evaluated in higher education? 2. What instruments are adopted to measure student outcomes?	Higher education	76 articles	• Educational and Psychological Science databases • External resources • Snowballing method	Content analyses	Provides direction for Chapters 3 and 4
Three	Empirical study	1. How is motivation related to evaluations of online collaborative PjBL? 2. How are strategies used related to evaluations of online collaborative PjBL?	• An 8-week online course for undergraduate students • A project from weeks 1 to 3 • Small group collaborative learning	81 students from 25 groups	Survey (individual level)	Partial least squares analyses	Addresses the limitations found in Chapter 2
Four	Empirical study	1. What components of social presence describe student groups' artifact creation in online discussions? 2. What levels of cognitive presence describe student groups' artifact creation in online discussions? 3. How is student social presence in online discussions related to the artifact performance? 4. How is student cognitive presence in online discussions related to the artifact performance?	• Online learning • Project artifacts: a film analysis report • ICT tools: Videoconferencing; WeChat	24 groups of 3 to 4 students	• Transcripts of online discussions (group level) • Grades of project artifact (group level)	• Content analyses • Descriptive statistics • Stepwise multiple regression analyses	• Addresses the limitations found in Chapter 2 • Provides direction for Chapter 5
Five	Empirical study	1. What is the relationship between students' perceptions of teaching presence and their evaluations of online PjBL in the first phase of the course? 2. What is the relationship between students' perceptions of teaching presence and their evaluations of online PjBL in the whole phase of the course? 3. Are these relationships mediated by students' perceptions of social presence and cognitive presence during the course?	• A 16-week online course for master students • Project I from weeks 1 to 4 • Project II from weeks 11 to 15 • Small group collaborative learning • Online learning • Project artifacts: a case analysis report and a course paper • ICT tools: Videoconferencing; WeChat;	• 38 students (phase 1) • 41 students (phase 2)	Survey (individual level; twice)	Partial least squares analyses	Explore the direction provided by Chapter 4

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