Chapter 3

The relationship between students' motivation, strategies, and evaluations of online collaborative project-based learning

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Abstract

Project-based learning is considered an alternative to teacher-centered direct instruction in higher education. This study examined how students' motivation for and strategies used were related to their evaluations of online collaborative project-based learning. An eight-week online project-based mental health course was implemented. During the course, students were engaged in educational activities and collaboratively created a final product (i.e. a film analysis report) with group members using WeChat as the communication tool. Survey data were collected from 81 students from 25 groups. Results from a partial least squares analysis showed that students' autonomous motivation and amotivation were positively and negatively related to students' evaluations, respectively. The strategies considering others' opinions and challenging others were positively related to students' evaluations. Practical implications for teachers and suggestions for further research are provided.

Keywords: Online project-based learning; Collaborative learning; Motivation; Strategy; Student evaluation

3.1 Introduction

The traditional, teacher-led instruction still dominates in compulsory courses in Chinese universities. With this instructional style, teachers, rather than students, perform activities, such as generating ideas, deciding the way of learning, and controlling the learning pace, whereas students passively receive knowledge (Alorda et al., 2011; Serin, 2018). As a result, learners might be deprived of the opportunity to actively participate in educational activities the way they want, which might lead to low learning motivation and satisfaction (e.g. Yin et al., 2016; H. Zhang et al., 2011). One way to improve this situation is to introduce the pedagogy of project-based learning (PjBL). PjBL indicates an active, student-centered teaching and learning process in which learners are engaged in the creation of artifacts based on real-world projects. Through the development of final products, students are expected to acquire and apply existing knowledge and eventually construct new knowledge. Previous review studies have shown that PjBL is positively related to various learning outcomes and could be considered an alternative to teachers' direct instruction in higher education (Chen & Yang, 2019; Guo et al., 2020). Given that the implementation of PjBL is still rare in Chinese university education, we have implemented PjBL and examined students' evaluations of it in a university compulsory course in order to better understand this methodology in this educational context.

Students' collaborative learning with peers is often integrated with PjBL (Chen & Yang, 2019; Dado & Bodemer, 2017). Raes et al. (2016) claimed that projects conducted through students' collaboration have great educational potential for both teaching and learning processes (e.g. Ellis & Hafner, 2008; Jawaid et al., 2020). However, previous studies have found that in PjBL some students experience difficulties with collaboration with their peers (e.g. Dauletova, 2014; Davenport, 2000; Lima et al., 2007; Raycheva et al., 2017; K. Zhang et al., 2009). These difficulties can be even more visible when students work together via computer-supported collaborative learning (CSCL) tools, such as online discussion forums. Students might misunderstand each other's intentions due to insufficient non-verbal cues (Murphy & Coleman, 2004;

Robinson, 2013). Also, their communication and interaction could decrease due to schedule conflicts (Heo et al., 2010). Furthermore, due to the openness and ill-structured features of PjBL, students need to conduct a series of collaborative activities to develop final products, such as defining problems, discussing ideas, and collecting and analyzing data. This process of knowledge construction is not easy and requires certain strategies. For example, students might have to exchange and confirm a lot of information before they can move to the next step and negotiate over different opinions to reach an agreement. Thus, because of all of these challenges in combination with the Chinese educational context, a concern arises whether students who are not used to collaborate are motivated for online collaborative PjBL and how their motivation might affect learning outcomes, which few previous studies have investigated (e.g. Urquiza-Fuentes & Paredes-Velasco, 2017; T.-T. Wu et al., 2018). In addition, while some studies have reported students' strategies adopted in online collaborative PjBL, little empirical data are available about how these strategies are related to learning outcomes (e.g. Cudney & Kanigolla, 2014; S.-Y. Wu et al., 2013).

In this study, we aim to investigate students' motivation for and strategies adopted in online collaborative PjBL and their potential influence on students' evaluations of this learning approach. The findings might develop a deeper understanding of students' motives and learning processes in an online collaborative learning environment and contribute to the improvement of future PjBL curricula, especially for students who are not familiar with collaboration.

3.2 Theoretical background

3.2.1 Self-determination theory and motivation

Motivation is a core element in active learning that keeps students being involved in authentic projects (Urquiza-Fuentes & Paredes-Velasco, 2017). While various definitions of motivation can be found in the literature to understand its role in learning (Rienties et al., 2012), this study has adopted the Self-Determination Theory (SDT; Deci & Ryan, 1985) as the theoretical framework. 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 this study as they participated in a specific project for a few weeks to collaboratively develop the final artifact.

Based on SDT, motivation can be structured in three aspects: intrinsic motivation, extrinsic motivation, and amotivation. Intrinsic motivation indicates students' doing of an activity due to their inherent interests and enjoyment rather than rewards. Extrinsic motivation refers to learners' conduction of an activity because of external outcomes. Extrinsic motivation contains four categories, based on the degree to which it is autonomous: external regulation, which values the importance of extrinsic rewards or punishments, introjection, which is related to the approval from self or others, identification, which focuses on the self-endorsement of goals, and integration, which is fully volitional (Deci & Ryan, 1985; Ryan & Deci, 2000). According to Vansteenkiste et al. (2010), two types of motivation can be further identified based on the original ones: autonomous motivation, including identified regulation, integrated regulation and intrinsic motivation, and controlled motivation, namely external regulation and introjected regulation. In addition, amotivation describes the state that students are not motivated by either autonomous or controlled motivation and lack an intention or willingness to engage in learning activities (Deci & Ryan, 1985; Säfvenbom et al., 2015).

A number of recent studies have reported that autonomous motivation can lead to positive student cognitive learning outcomes, both objective performance (e.g. Areepattamannil et al., 2011; Calderón et al., 2020; Gillet et al., 2013; Khalaila, 2015; Kusurkar et al., 2013; H. Wu et al., 2020) and perceived learning (e.g. Ferreira et al., 2011; Jeno et al., 2017; Waheed et al., 2016). For example, Jeno et al. (2019) investigated the effect of autonomous motivation within three different learning conditions on students' academic achievement. The results showed that autonomous motivation triggered by the mobile learning tool positively accounted for students' knowledge test achievement. Buil et al. (2019) revealed that students' intrinsic motivation for

playing business simulation games directly and indirectly, through the effects of engagement, predicted their business skill development and perceived course learning. However, Schulte-Uentrop (2020) found that autonomous motivation of medical students did not contribute to their performance of non-technical skills.

Many studies have found that controlled motivation can undermine students' performance (e.g. Gillet et al., 2013; Waheed et al., 2016). For example, Areepattamannil et al. (2011) reported that the effect of controlled motivation on academic achievement can be either negative or non-significant, depending on different groups of students. Moreover, controlled motivation and autonomous motivation can jointly affect performance (e.g. Lei, 2010). Liu et al. (2020) found that controlled motivation undermined the academic performance of learners with high autonomous motivation, but improved the performance of learners with low autonomous motivation. In addition, controlled motivation could also promote cognitive achievement (e.g. Konheim-Kalkstein & van den Broek, 2008). Based on a national survey, H. Wu et al. (2020) reported that medical students' controlled motivation predicted their academic performance through learning engagement. Furthermore, Cheo (2017) found that different types of controlled motivation, such as rewards and encouragement, improved student performance in different stages.

Similar to controlled motivation, studies about amotivation have reported that learners who lack motivation usually have poor academic performance (e.g. Cokley, 2003; Gillet et al., 2013; Turner et al., 2009). For example, Balkis (2018) found that various dimensions of amotivation, such as low ability beliefs and low effort beliefs, negatively predicted high school students' GPA. Moreover, Próspero and Vohra-Gupta (2007) found that the negative effects of amotivation on student performance were significant and insignificant for first-generation college students and non first-generation students, respectively. Furthermore, Komarraju et al. (2009) reported that amotivation did not explain any significant variation in student academic achievement.

A limited number of studies have explored the relationship between students' motivation and satisfaction (e.g. Chau & Cheung, 2018; Eom et

al., 2006; Kwon et al., 2019). For example, Bailey et al. (2020) investigated the effects of EFL learners' intrinsic motivation for both synchronous and asynchronous communication on course satisfaction. The results showed that students' motivation for asynchronous online collaborative writing was positively related to satisfaction, while their motivation for synchronous videoconference activities had no impact on satisfaction. Ferriz et al. (2013) reported how student motivation in PE courses influenced their course satisfaction. The findings revealed that for males, course satisfaction was only related to autonomous motivation in a positive way. For females, satisfaction was positively related to both autonomous and controlled motivation and negatively related to amotivation.

3.2.2 Learning strategies in PjBL

Some studies have explored both students' individual use of strategies and the strategies adopted during collaboration with peers in PjBL. Regarding the individual level, Barak and Dori (2005) investigated chemical students' strategies used in the construction of digital molecular models during computer-assisted PjBL. The analysis of student interviews and teacher observations revealed that learners adopted five phases of approaches to construct the model, which showed a low to a high level of students' understanding of molecular structures. Stefanou et al. (2013) compared the learning strategies used by students during both problem-based learning (PrBL) and PjBL. Different from PjBL, in PrBL students usually focus on acquiring the existing knowledge by solving well-structured problems. Survey results showed that the level of PjBL group students' use of some strategies, such as elaboration and critical thinking, was significantly higher than that of their PrBL counterparts. H.-T. Hou et al. (2007) investigated students' strategies for peer assessment in online PjBL. During the course, each student first completed a project and wrote a report, and then gave feedback on each other's report in an online forum. The coding results of students' comments revealed that the most frequently used strategy was information sharing. Moreover, the sequence analysis showed that learners repeated in strategies of information sharing and off-topic discussions and had

no sequence correlations with other strategies, such as disagreement detection and negotiation of meaning.

As for the use of strategies in groups, Heo et al. (2010) explored how students constructed knowledge in online collaborative PjBL. Content analyses of student online discourse showed that both groups with low and high project performance used the strategy of information sharing. The high-performance groups, however, adopted further strategies, such as disagreement detection, goal clarification, and negotiation of meaning. S.-Y. Wu et al. (2013) compared students' knowledge construction with team members in both online PjBL and PrBL. The coding results of students' discussions revealed that in both learning environments, learners adopted strategies of information sharing, disagreement detection, negotiation of meaning, and off-topic. Students also adopted the strategy of testing and modification of new ideas. Furthermore, the sequence analysis showed that when disagreement occurred, learners in PjBL tried to negotiate over it and reach an agreement, which however, did not show in PrBL. These findings suggest that the use of strategies can be related to students' collaboration in PjBL.

3.2.3 Research questions

This study aims to provide more insight into students' motivation for, strategies used in, and evaluations of online collaborative PjBL and the associations among them. Hence, the research questions are as follows.

1. How is motivation related to students' evaluations of online collaborative PjBL?
2. How are strategies used related to students' evaluations of online collaborative PjBL?

3.3 Method

3.3.1 Research context

An eight-week online Introductory Course on Mental Health for the freshmen in a Chinese university was implemented. In the first to third weeks, students watched 26 recorded instruction videos on the MOOC platform of the university. These videos contained the basic content knowledge that students needed to learn and they were free to choose the watching sequence. In weeks four to seven, learners attended online lectures where the teacher further explained certain important topics and theories. In week eight, students took a final paper-pencil exam.

During the first three weeks, students participated in a project-based group activity and created a final product (i.e. a film analysis report) in small groups of 3-4 via an instant messaging app (i.e. WeChat). The aim of this group activity was to help students learn and understand and apply the content knowledge through the creation of artifacts together, and eventually construct new knowledge. In specific, students were first asked to watch four films provided that were closely related to this course and choose one of them for further analysis. Since the aim of this course was not about professional film analysis, students did not analyze the entire film. They only needed to select certain excerpts of that film and analyze them based on the topics and theories that they learned from the recorded instruction videos. The teacher provided students with some suggestions to complete the film report and the grading criteria for the report. During the whole process, students were asked to discuss everything about the group activity in their WeChat discussion groups.

3.3.2 Participants, procedures, and data source

Before the first week, students divided themselves into 25 small groups of 3 to 4 and built their own WeChat discussion groups. In the first class, one of the researchers introduced the research design via video conferencing with explanation documents. At the end of the second week, 95 students (M_{age} =

18.96, Male = 20) answered the motivation questionnaire. After submitting the film report at the end of the third week, 85 students (M_{age} = 19.00, Male = 17) reported their strategies used and gave their evaluations of the group activity. In total, 81 students (M_{age} = 18.94; Male = 15) finished both surveys. The conduction of research and data collection were approved by the director of the institute. These procedures observed the ethical requirements for educational research. All participants provided consent.

3.3.3 Measures

Motivation for online collaborative PjBL was measured by 16 items via the Situational Motivation Scale of Guay et al. (2000). After Principal Component Analysis (PCA) with Oblimin rotation on these 16 items, item 10 was excluded due to low factor loading. Three factors of the rest 15 items with a cumulative explained variance of 73.49% were extracted: autonomous motivation (items 1, 2, 5, 6, 9, 13, 14, Cronbach's α = 0.938), controlled motivation (items 3, 7, 11, 15, Cronbach's α = 0.701), and amotivation (items 4, 8, 12, 16, Cronbach's α = 0.815).

Strategies for online collaborative PjBL were measured by 13 items based on the work of Junus et al. (2019). After PCA with Oblimin rotation on these 13 items, item 13 was excluded due to low factor loading. Item 12 was left out because its latent meaning is different from other items. Thus, four factors of 11 items with a cumulative explained variance of 77.74% were extracted: consider others' opinions (items 1 to 4, Cronbach's α = 0.865), challenge others (items 10 and 11, Cronbach's α = 0.784), observe others (items 5 and 6, Cronbach's α = 0.810), and confirm information (items 7 to 9, Cronbach's α = 0.732).

Students' evaluations of online collaborative PjBL was measured by 11 items based on the work of So and Brush (2008) and Parmelee (2009). Two factors with a cumulative explained variance of 77.46% were extracted after PCA with Oblimin rotation: perceived benefits (items 1 to 5, Cronbach's α = 0.923) and satisfaction (items 6 to 11, Cronbach's α = 0.930).

The measure for motivation adopted a 7-point Likert-type rating scale, as used in the original scale of Guay et al. (2000), from 1 = corresponds not all to

7 = corresponds exactly. The other measures were ranging from 1 = very much disagree to 6 = very much agree. The design of the 6-point Likert-type scale is to avoid participants choosing neutral answers. An overview of all original measures and their corresponding items are presented in Appendix 1.

3.3.4. Analyses

To answer the two research questions, partial least squares (PLS) analyses were performed using SmartPLS 3.0 developed by Ringle et al. (2015) with the three motivation variables and the four strategies variables as independent variables and the two evaluation variables as dependent variables. The PLS analysis was adopted in this study because, according to Hair et al. (2011), a) the aim of this study is to identify the predictors to students' evaluations, b) the sample size is relatively low (i.e. 81 students).

3.4 Results

3.4.1 Measurement model

To evaluate the reliability and validity of the measurement model using PLS, several indicators should be reported (Hair et al., 2011; Urbach & Ahlemann, 2010). Regarding the reliability, in exploratory research indicator loadings of each item can be accepted between 0.6 to 0.7. To meet the internal consistency reliability, Cronbach's alpha (CA) of each variable should not be lower than 0.60 and the composite reliability (CR) should be greater than 0.70. As for the validity, the average variance extracted (AVE) should be greater than 0.50 to meet the standard of convergent validity. To test the discriminant validity, the square root of each variable's AVE should be greater than the correlation of the variable to other variables.

Two items of controlled motivation (items 3 and 7) were deleted due to low factor loadings. Results showed adequate CA, CR, and AVE (see Table 3.1) of the measurement model. Hence, the reliability and validity of the measurement model are supported.

3.4.2 Structural model

To test the structural model, Bootstrapping with 5000 subsamples was conducted. The results showed that the R^2 for perceived benefits was 0.64, suggesting the model explained 64% of the variance of students' perceived benefits of PjBL. The R^2 for satisfaction was 0.52, indicating the model explained 52% of the variance of students' satisfaction with PjBL. Table 3.2 presents the results of the path coefficients for the model.

Regarding motivation variables, autonomous motivation positively influenced both perceived benefits (Path 1: $\beta = 0.365, p < 0.001$) and satisfaction (Path 2: $\beta = 0.335, p < 0.01$), while amotivation had a negative impact on both perceived benefits (Path 5: $\beta = -0.212, p < 0.01$) and satisfaction (Path 6: $\beta = -0.271, p < 0.01$). No significant influence was observed by controlled motivation and both perceived benefits and satisfaction (Path 3 and 4). In terms of each strategy, considering others' opinions positively impacted perceived benefits (Path 7: $\beta = 0.292, p < 0.01$). However, it had no influence on satisfaction (Path 8). Challenging others positively influenced both perceived benefits (Path 9: $\beta = 0.248, p < 0.01$) and satisfaction (Path 10: $\beta = 0.230, p < 0.05$). Both strategies that observing others and confirming information had no impact on perceived benefits and satisfaction (Path 11 to 14).

Table 3.1. *Means, Standard Deviations, Reliabilities and Correlation of Variables (N = 81)*

Variables	Number of items	Mean	SD	CA	CR	Correlation of Variables and AVE								
						1	2	3	4	5	6	7	8	9
1. Autonomous motivation	7	4.256	1.358	0.929	0.943	**0.839**								
2. Controlled motivation	2	3.605	1.697	0.763	0.835	-0.406	**0.850**							
3. Amotivation	4	3.009	1.326	0.820	0.879	-0.404	0.367	**0.804**						
4. Consider others' opinions	4	5.580	0.482	0.887	0.921	0.166	0.043	-0.213	**0.863**					
5. Challenge others	2	4.308	1.203	0.775	0.881	0.226	-0.127	-0.116	0.124	**0.888**				
6. Observe others	2	5.019	0.835	0.813	0.914	0.050	-0.091	-0.071	0.422	0.302	**0.917**			
7. Confirm information	3	5.190	0.728	0.749	0.856	0.160	-0.203	-0.236	0.460	0.293	0.322	**0.816**		
8. Perceived benefits	5	5.052	0.814	0.928	0.945	0.559	-0.231	-0.466	0.519	0.445	0.354	0.445	**0.881**	
9. Satisfaction	6	4.856	0.890	0.942	0.954	0.546	-0.316	-0.491	0.345	0.407	0.318	0.311	0.763	**0.882**

Note: 1. Diagonal elements in the correlation of constructs matrix are the square root of the AVE. 2. Motivation variables (variable 1 to 3) range from 1 to 7. Other variables range from 1 to 6.

Table 3.2. *Results of path coefficients (N = 81)*

Path	Relationship	β
1.	Autonomous motivation →Perceived benefits	0.365*** (4.753)
2.	Autonomous motivation → Satisfaction	0.335** (3.295)
3.	Controlled motivation →Perceived benefits	0.050 (0.462)
4.	Controlled motivation → Satisfaction	-0.048 (0.371)
5.	Amotivation → Perceived benefits	-0.212** (2.855)
6.	Amotivation → Satisfaction	-0.271** (2.777)
7.	Consider others' opinions →Perceived benefits	0.292** (3.101)
8.	Consider others' opinions →Satisfaction	0.169 (1.817)
9.	Challenge others →Perceived benefits	0.248**(3.527)
10.	Challenge others → Satisfaction	0.230*(2.532)
11.	Observe others → Perceived benefits	0.126 (1.869)
12.	Observe others → Satisfaction	0.097 (0.834)
13.	Confirm information →Perceived benefits	0.092 (1.030)
14.	Confirm information → Satisfaction	-0.003 (0.027)

Note: * p < .05, ** p < .01, *** p < .001. T statistics are in parenthesis.

3.5 Discussion

3.5.1 Motivation and evaluation

Regarding the first research question, the results showed that autonomous motivation was positively related to students' evaluations, consistent with the findings from previous studies (e.g. Buil et al., 2019; Ferriz et al., 2013). First, this means students reported more sense of learning and satisfaction when they reported stronger feelings of inherent interests and enjoyment from conducting this project. Two features of this project might explain this result. First, this project was authentic and related to the real-world. The topics students learned and discussed in this course, including happiness, self, relation, and life, are closely related to students' daily life and can be found in the film provided. Certain film excerpts are actually the epitome of real life. In other words, the analysis of these excerpts is an analysis of the life experience in the real world. Therefore, during this process students had many opportunities to connect their life experiences with course materials. This might not only contribute to their deeper understanding of the content knowledge but also help them reflect on their lives. Second, WeChat was fully used for students' knowledge construction in this project. While WeChat is one of the most frequently used instant messaging tools, it is barely used for learning purposes. Using WeChat to collaboratively develop the final product might be novel and interesting for students, and therefore, they might put more effort in this process. Moreover, WeChat has some advantages in comparison to other digital technologies (e.g. online discussion forums and videoconferencing). The most important aspect is that there are diverse forms of communication on WeChat, including text messages, emojis and stickers, uploaded pictures and documents, audio messages, and audio calls. Students can adopt multiple ways as needed to efficiently interact with each other, both synchronously and asynchronously. In particular, students usually use positive humor in communication, which makes the learning atmosphere vivid and satisfying. Besides, learners can easily access WeChat as they can use it seamlessly on multiple devices and do not need to log in to it frequently. This makes the process of knowledge construction easier.

Moreover, the positive relationship between autonomous motivation and students' evaluations also means that the more learners perceived this project benefited their personal development, the more sense of learning and satisfaction they felt from doing it. This might because students not only acquired hard skills (i.e. content knowledge) but improved their soft skills during the development of the film analysis report. Students were engaged in a series of collaborative activities, such as selecting film excerpts, deciding topics and methods, and revising manuscripts. In each activity, learners needed to complete a learning loop of "propose ideas–receive feedback–negotiate–reach agreements". In so doing, their teamwork, problem-solving, and critical thinking skills could be enhanced.

In addition, the results revealed that amotivation negatively predicted students' evaluations. That is to say, the more that students felt unmotivated for completing the project, the less perceived benefits and satisfaction they felt from this learning process. This is in line with findings from previous studies (e.g. Balkis, 2018; Ferriz et al., 2013). This might relate to students' lack of the intention to invest effort in this project because they might not see the value of doing it. In the study of Legault et al. (2006), the authors revealed that learners' perceptions of the value of the task is one of the reasons for their amotivation for learning. Moreover, amotivation might also increase students' negative emotions and undermine positive emotions in learning (Gillet et al., 2013). All of these could lead to less performance and lower satisfaction (e.g. Gillet et al., 2013; Legault et al., 2006).

Finally, the relationship between controlled motivation and students' evaluations was not significant. This means external factors (e.g. pressure to take the course) did not influence students' perceived benefits and satisfaction. This result is different from many previous studies that reported significant relationships between controlled motivation and learning outcomes, both positively and negatively (e.g. Cheo, 2017; Liu et al., 2020; H. Wu et al., 2020). This might because students in this study were not unwilling to participate in PjBL and did not see PjBL as either a burden or incentive to their study.

3.5.2 Strategies and evaluation

Regarding the second research question, the results showed that the more students considered peers' opinions when they wrote the film report, the more sense of learning they felt. This was in line with previous studies that investigated students' engagement and perceptions of learning in online discourse (e.g. Bain, 2011). Reflecting on others' opinions can be beneficial to students' deeper understanding of the course material. Moreover, the process of thinking of and accepting others' ideas is the process of learning different perspectives from other people. This might allow students to think outside the box and change their inherent thinking model, which further improves their critical thinking skills.

The results also revealed that challenging peers' opinions increased students' perceived benefits from the creation of the film analysis report. This might support the claim of Nguyen-Phuong-Mai (2019) that constructive discussions and valuable outcomes might stem from differences of opinion. When students question the ideas of their peers, it usually means that they are able to put forward their own opinions after thoughtful thinking. That is to say, only when the challengers have carefully thought about the issues discussed, will their opinions be meaningful and might be accepted by other team members. As a result, challengers will be encouraged to think deeply and extensively, which might not only deepen their understanding of the content knowledge but also improve their thinking ability.

The results further showed that learners felt satisfied with the collaborative activity, even if they challenged each other. This is different from previous studies (e.g. Wei et al., 2013; Zhu, 2012) that have found students who grow up with an East Asian education background normally tend to pursue harmony and avoid direct confrontation and conflict with others in collaboration. The personal emotions of students who engaged in the film analysis report writing were not harmed by expressing differences, perhaps because they perceived safety during the collaboration and therefore, had the way to openly express their feelings and opinions. Two settings of this project might contribute to this. First, when using asynchronous discussions in WeChat, information can be presented after

careful wording. Besides, students can use emojis and stickers to express their emotions and attitude. These can avoid the potential conflict, embarrassment, and shame that may occur in synchronous communication. Second, all learners were grouped by themselves rather than by the teacher. In other words, students in the same team were familiar with each other. Previous studies have reported that Chinese students prefer to work with familiar peers (M. Wang, 2007; K. Zhang et al., 2009). Forming teams by friendship may help learners directly express their true opinions without being too concerned about the feelings of others, which might contribute to group cohesiveness (e.g. Q. Wang, 2009).

3.5.3 Implications for practice

A first implication for the practice of this study can be related to project design. In order to help students be motivated in learning, the selection and design of the project and the educational activities should be authentic. In particular, the design of the final product should be closely connected to students' real life. Second, teachers should encourage learners to listen to each other during collaboration and try to question peers' ideas and put forward their own opinions. One way to do so is to ask students to write the reflection diary in which they summarize peers' different opinions on a daily basis. Besides, students can anonymously comment on everyone's work and propose their improvement suggestions. Third, teachers should create a safe and comfortable atmosphere for students' collaboration, so as to encourage them to openly express their feelings, attitude, and opinions without worries. Encouraging students to form their own groups and use multifunctional educational technologies to collaborate are two possible ways.

3.5.4 Limitations and future directions

A first limitation of this study is related to the lack of the investigation of potential factors predicting motivation. While SDT was used as the theoretical foundation, the classic three psychological needs of this theory, namely the need for autonomy, competence, and relatedness, were not included. Future studies could explore what kind of role do these needs play during PjBL. In

addition, since the feature of the authenticity of PjBL and the use of ICT tools might impact student motivation and learning outcomes, future research could investigate their role as well. Second, future studies could adopt an explanatory sequential design (Creswell, 2012; Leavy, 2017) that helps with the explanation of quantitative results via follow-up data collected from qualitative methods, such as interviews and diaries. Last, the generalizability of the results of this study is limited due to the small sample of students. Future research could integrate online PjBL with MOOCs that provide large samples from various disciplines in order to increase the generalizability and fully understand this method.

3.6 Concluding remarks

This study has contributed to our understanding of college students' motivation for and strategies used in online collaborative project-based learning. It can be concluded from the results that autonomous motivation and amotivation is positively and negatively related to students' perceived benefits and satisfaction, respectively. Both strategies considering others' opinions and challenging others are positively associated with students' perceived benefits. In addition, challenging others is also related to students' satisfaction with project-based learning. These findings can serve as guidelines on the better design of future project-based curricula and educational activities.