Teacher and Student Intrinsic Motivation in Project-Based Learning

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Abstract

This study examined the relationship between teacher and student intrinsic motivation in project-based learning. Participants were 126 Hong Kong secondary school teachers and their 631 students who completed evaluation questionnaires after a semester-long project-based learning program. Both teachers and students were asked to indicate their motivation in the program. In addition, students were asked to report the instructional support they received from their teachers. The results of hierarchical linear modeling analyses showed that teacher intrinsic motivation predicted student intrinsic motivation directly as well as indirectly through the mediation of instructional support. When teachers reported higher intrinsic motivation in the program, their students tended to perceive getting more support from them and to report higher intrinsic motivation in the learning experience.

Teacher and Student Intrinsic Motivation in Project-Based Learning

At the turn of the millennium the Hong Kong government initiated a large-scale education reform concerning all stages of education from early childhood to continuing adult education (Education Commission, 2000). Like the large-scale education reforms that have been launched since the 1990s in western countries (Fullan, 2000), the education reform in Hong Kong has been propelled by a strong demand from society that students learn how to meet the challenges of a knowledge-based and fast-changing society. Schools are required to promote not only subject area knowledge but also generic skills such as collaboration, communication, and problem-solving skills. To equip students with these skills, teachers are encouraged to use more student-centered approaches in teaching. Project-based learning is one of these student-centered approaches that have been recommended highly in the reform.

Project-based learning is a part of the instructional approaches originating from Dewey (1938), who argued for the importance of practical experience in learning. In project-based learning, students work in small groups on academic tasks. The task can be in the form of investigation and research on a particular topic. The topic being studied usually integrates concepts from a number of disciplines or fields of study (Blumenfeld, et al., 1991). Students in a small group collaborate with one another to reach a collective outcome over a period of time. They pursue solutions to a problem by asking and refining questions, debating ideas, making predictions, collecting and analyzing data, drawing conclusions, and communicating their findings to others. This approach is widely believed to be a powerful teaching strategy that can enhance student motivation and promote self-directed learning because the learning issues usually arise from the problems in which students are interested (Hmelo-Silver, 2004). According to

the Hong Kong curriculum reform proposal (Curriculum Development Council, 2001), project-based learning is described as a teaching strategy that will “enable students to connect knowledge, skills, values, and attitudes and to construct knowledge through a variety of learning experiences” (p. 87).

Despite its popularity among education reformers, project-based learning is not readily accepted by all teachers in Hong Kong. Watkins and Biggs (2001) have poignantly commented that many innovations imported from overseas to Hong Kong are like organ transplants that are rejected. Project-based learning, as a new teaching approach from western countries, is expected to encounter skepticism and even resistance from local teachers whose cultural background is different from that of their western counterparts. A recent study (Tse, Lam, Lam & Loh, 2005) showed that, although student-centered teaching practices are officially recommended, most Hong Kong Chinese language teachers still employ teacher-led approaches to explain teaching materials to students. Their reluctance is understandable. The new practices bear little resemblance to either their current practices or to the methods they had learned and experienced as student themselves.

While the benefits of project-based learning for students remain to be seen, few would argue that a key factor contributing to its successful implementation in the local setting hinges on teacher motivation in using this new teaching approach. Project-based learning will have a better chance to bring about the desired benefits, such as improved motivation for students, if teachers themselves have a strong motivation to experiment with and improve it in the classroom.

According to the self-determination theory (Deci & Ryan, 1985, 1991), intrinsic motivation involves the highest degree of self-determination. It refers to having inherent enjoyment in doing the task. In the present study, we focused on intrinsic

motivation because it is desirable to enhance intrinsic motivation in both teachers and students. Previous studies have demonstrated consistently the positive effects of intrinsic motivation on performance, self-esteem, persistence, and emotional outcomes (Deci & Ryan, 1995; Grolnick & Ryan, 1987; Patrick, Skinner, & Connell, 1993).

The purpose of the current research was to investigate how teacher intrinsic motivation was related to student intrinsic motivation in project-based learning. Is the association between the two variables an indirect relationship that involves mediators such as instructional practices? Or is this association a direct relationship that does not involve mediators but simply reflects infection or modeling? Understanding of the underlying mechanisms that contribute to such an association will be helpful to educators who are concerned about enhancing student learning motivation in project-based learning.

Instructional Practices as Mediator

Instructional practices may be a possible mechanism that mediates the correspondence between teacher and student motivation. Previous research has shown that intrinsic and extrinsic motivational factors of teachers may affect their instructional practices and, in turn, enhance or diminish student motivation. Several studies have indicated how contextual factors may affect teachers' instructional practices. In an early study, Garbarino (1975) found that externally constrained (i.e., rewarded) teachers had a more critical and controlling instructional style than unconstrained (i.e., volunteer) teachers. Similarly, Deci, Spiegel, Ryan, Koestner, and Kauffman (1982) found that teachers who were led to feel responsible for their students' performing up to standard were more controlling than teachers who were not. Teachers in the former condition were more critical of the students, talked more, gave more commands, and allowed less choice and autonomy. In a more recent study, Pelletier, Séguin-Lévesque, and Legault

(2002) found that the more teachers perceived pressure from above (i.e., they had to comply with curriculum, with colleagues, and with performance standards) and pressure from below (i.e., they perceived their students to be unmotivated), the less their teaching was motivated intrinsically. Consequently, they became more controlling and less supportive of autonomy in their students.

Different instructional practices are known to have different outcomes in student intrinsic motivation. For example, Ryan and Grolnick (1986) found that the more students perceived autonomy support in the classroom, the higher they reported self-worth, cognitive competence, internal control, and mastery motivation. In another study, Grolnick and Ryan (1987) found that non-controlling instruction resulted in greater interest and conceptual learning in students when compared with controlling instruction. Similarly, Cordova and Lepper (1996) found that a teaching strategy providing choices could produce dramatic increases in students' intrinsic motivation and engagement in learning. In a recent study, Assor, Kaplan, Kanant-Maymon, and Roth (2005) also reported that children's perceptions of their teachers as controlling aroused their anger and anxiety. These negative emotions would, in turn, enhance extrinsic motivation in children and eventually diminish their academic engagement.

The studies reviewed above focused on the relation between autonomy-supportive instruction and student intrinsic motivation. Nevertheless, student intrinsic motivation is not only subject to autonomy-supportive instruction; it is also subject to a myriad of teaching practices, such as presenting challenging work to students, integrating real-life significance to their learning activities, stimulating their curiosity in the learning tasks, acknowledging their efforts or improvement, and providing them with useful feedback (see Stipek, 1996, for a review). These teaching practices are aimed at increasing the value and probability of success in learning activities so as to enhance students'

intrinsic motivation. They are based primarily on the major social-cognitive theories of motivation that have generated numerous studies in the past three decades (Eccles & Wigfield, 2002). These social-cognitive theories include value-expectancy theory (Atkinson, 1964), self-efficacy theory (Bandura, 1977), attribution theory (Weiner, 1986), and goal orientation theory (Dweck, 1986). The teaching practices derived from these social-cognitive theories can be categorized as cognitive support for student intrinsic motivation because of their relevance to social cognition (e.g., self-efficacy, attribution, and goal orientation) and its impact on student intrinsic motivation.

In recent years, however, researchers have argued that in addition to cognitive support, affective support also plays a decisive role in student motivation. For example, Meyer and Turner (2002) point out that emotion should be considered in the study of motivation in classroom interactions because it intertwines with teacher-student relationships and constitutes an integral part of the interpersonal processes that create classroom contexts. Ryan and Deci (2000) also state in their self-determination theory that any social contexts that promote a sense of interpersonal relatedness are likely to facilitate intrinsic motivation. These arguments about emotion and interpersonal relatedness have prompted researchers to consider the motivational benefits of good teacher-student relationships. Instructional practices that promote student intrinsic motivation not only include cognitive support such as providing challenging work, choices, and useful feedback, but also include affective support that helps to build a healthy and satisfying teacher-student relationship. In fact, some researchers (e.g., Furrer & Skinner, 2003; Skinner & Belmont, 1993; Turner, et al., 2002; Wentzel, 1997) have shown that teachers' caring attitudes or students' feelings of relatedness to teachers can predict student motivation.

Direct Association between Teacher and Student Intrinsic Motivation

The aforementioned research provides evidence supporting the thesis that the correspondence between teacher and student intrinsic motivation is mediated significantly by teachers' instructional practices. However, there may be alternative explanations regarding the correspondence between teacher and student intrinsic motivation without involving teachers' instructional practices. One possible explanation is modeling. In Cellar and Wade's (1988) study, participants were asked to assemble Erector set parts after watching a videotape portraying a person exhibiting either an intrinsic or an extrinsic motivational orientation toward the task. The results showed that merely perceiving the target person exhibiting enjoyment and persistence led to enhanced intrinsic motivation in the perceivers when they subsequently engaged in the activity. Cellar and Wade (1988) explained their results with imitative learning or modeling (Bandura, 1977). In a more recent study, Hendy and Raudenbush (2000) also found that enthusiastic teacher modeling versus silent teacher modeling could encourage new food acceptance among preschool children. Their results suggested that it was not modeling per se but modeling of motivational orientations that contributed to the preschoolers' acceptance of new foods. Since students tend to imitate the motivational orientations of their teachers, teacher motivation may have a direct effect on student motivation. The correspondence between teacher and student intrinsic motivation may not involve instructional practices. It is not the instruction but the intrinsic motivation of the teacher that contributes to the correspondence.

In summary, there are at least two possible explanations for the correspondence between teacher and student intrinsic motivation. One involves instructional practices and one does not. If it involves instructional practices, teachers with high intrinsic motivation may provide strong instructional support to their students and this support, in turn, may have positive impact on student intrinsic motivation. If it does not involve

instructional practices, the correspondence between teacher and student intrinsic motivation may be a function of imitative learning or modeling. Disregarding the instructional practices they have experienced, students may get clues about the inherent enjoyment of the task from observing the motivational orientation of their teachers.

Research Questions and Hypotheses

The two explanations mentioned above may generate three possible models, namely the direct effect model, the complete mediation model, and the partial mediation model (see Figure 1). In the present study, we examined each of these models. In the direct effect model, the correspondence between teacher and student motivation does not involve instructional support. This means that only Path C would be significant while both Paths A and B would be non-significant. In the complete mediation model, instructional supports mediate completely the effects of teacher motivation on student motivation. This means that both Paths A and B would be significant but Path C would be non-significant. In the partial mediation model, instructional support partially mediates the effects of teacher motivation on student motivation. Teacher motivation predicts student motivation directly as well as through the mediation of instructional support. That means all three paths would be significant. Path C is the unique contribution of teacher motivation to student motivation after instructional support perceived by students is controlled for. Among the three models, we expected that the partial mediation model would be the most possible because it was likely that teacher motivation had both direct and indirect effects on student motivation.

(Insert Figure 1 about here)

Method

Participants

The participants were 126 teachers and their 631 students from four secondary

schools in Hong Kong. The four schools were located in different districts and varied in socioeconomic backgrounds and academic standards. They implemented project-based learning in response to the curriculum reform in Hong Kong (Curriculum Development Council, 2001). To assess the effectiveness of this new teaching approach, the administrators of these schools invited our research team from a local university to conduct an evaluation. The data reported in this paper are part of the data collected for this evaluation project. Of the 126 teachers who participated in this study, 46% were males and 54% were females. In the student sample, the ratio between males and females was approximately 1 to 1. About 24% were 7^{th} graders, 5% were 8^{th} graders, and 71% were 9^{th} graders.

Procedures

In each school, five to six students were assigned to a small group and studied a topic of interest under the supervision of a teacher. Each teacher supervised one group only. The topics of the projects were diverse and multi-disciplinary in nature (e.g., air pollution in Hong Kong, teenage hip-hop culture). These projects mostly lasted for two to three months. Each group of students was required to submit a written report and to give an oral presentation on what they had learned about the topic at the end of the project. One or two weeks after the students completed their projects, they were asked to complete an evaluation questionnaire in their classrooms on a normal school day. The questionnaire was in Chinese and administered by the researchers from the university. Most students were able to complete the questionnaire within 25 minutes. As the survey contained some sensitive items tapping their perceptions of instructional support provided by their teachers, the survey was administered without the presence of their teachers. At about the same time, the teachers were also asked to complete an evaluation questionnaire, either at home or at school, which they returned a week later

in a sealed envelope to the school secretary. This procedure was adopted to ensure that the teachers could complete the questionnaire at their convenience without the monitoring of school administrators. The teacher questionnaire was also in Chinese. All students and teachers were informed that their participation was voluntary and that their answers and identities would remain confidential. They were also informed that their data would be reported collectively and used for research purposes only.

Measures

Teacher intrinsic motivation. A scale of four items was developed to measure the extent to which the teachers participated in the project-based learning activity for intrinsic motivation (e.g., “I participated because learning new teaching approaches is enjoyable”). These items were adapted from the intrinsic motivation subscale of Self-Regulation Questionnaire (Ryan, & Connell, 1989) and Stepping Motivation Scale (Hayamizu, 1997). Teachers were asked to indicate their agreement to each item on a 6-point scale, ranging from 1 (strongly disagree) to 6 (strongly agree). Cronbach’s alpha of the four items was .87 in the current sample, indicating satisfactory internal consistency. The average score of these four items was used to indicate teacher intrinsic motivation in project-based learning.

Student intrinsic motivation. Students were asked to indicate their intrinsic motivation in the project-based learning activity by responding to a scale of student intrinsic motivation that was adapted from the one used in Elliot and Church's study (1997). The scale consists of six items (e.g., “I enjoyed working on the project very much”). Students were asked to indicate their agreement to each of the items on a 6-point scale, ranging from 1 (strongly disagree) to 6 (strongly agree). Cronbach’s alpha of this scale was .90 in the current sample, indicating high internal consistency.

The average score of the six items was used to indicate student intrinsic motivation in project-based learning.

Cognitive support. Cognitive support from teachers was measured by the Motivating Instructional Contexts Inventory (MICI) (Lam, Pak, & Ma, 2007). The MICI is a student-report measure that describes the extent to which teachers provide cognitive support that will enhance students' motivation. This inventory was modified for the present study and the modified version is composed of 18 items grouped in 6 subscales (Challenge, Real Life Significance, Curiosity, Autonomy, Recognition, and Evaluation). The items tapped specifically the students' experiences with the project-based learning instead of their teachers' general cognitive support (e.g., "Our teacher lets us work on a topic of the right level, neither too difficult nor too easy"). Students were asked to indicate their agreement to each item on a 6-point scale, ranging from 1 (strongly disagree) to 6 (strongly agree). Cronbach's alpha of these six scale scores was .93 in the current sample, indicating high internal consistency.

Affective support. Students' perception of affective support was measured by a scale adapted from the Teacher Involvement subscale (short form) of the Teacher as Social Context questionnaire (TASC-Student Report) (Belmont, Skinner, Wellborn & Connell, 1992). This scale tapped the students' perception of care and warmth they received from their teachers during the period when they were engaged in the project-based learning work. It is composed of four items (e.g., "My teacher likes me and cares about me"). Students were asked to indicate their agreement to each item on a 6-point scale, ranging from 1 (strongly disagree) to 6 (strongly agree). The Cronbach's alpha was .88 in the current sample, indicating satisfactory internal consistency.

Instructional support. The correlation between the cognitive and affective supports was .61, $p < .001$. The average of these two scores was used to indicate the instructional support perceived by the students.

Analyses

In this study, the students ($N = 631$) were divided into 126 groups with each group supervised by one teacher. With this design, we had data about student motivation and perceived instructional support from 631 students and data about teacher motivation from only 126 teachers. As teacher and student variables were at different hierarchical levels, hierarchical linear modeling (HLM) (Raudenbush & Bryk, 2002) was used to conduct multi-level analyses.

Results

Descriptive Statistics and Correlations

In the sample of 631 students, the means of instructional support and student intrinsic motivation were 4.09 ($SD = .80$) and 3.68 ($SD = 1.13$) respectively. The zero-order correlation between these two variables was .60, $p < .001$. In the sample of 126 teachers, the mean of teacher intrinsic motivation was 3.99 ($SD = .95$).

Baseline Analyses

Before we ran full-model HLM analyses, we needed to determine the proportion of total variance that resided systematically between groups, grades, and schools, i.e., the intra-class correlation (ICC). Lee (2002) argues that researchers should consider a multi-level analytic method when the ICC is more than trivial (i.e., greater than 10% of the total variance in the outcome). To determine the ICC, we conducted analyses of unconditional model using HLM 5 (Raudenbush, Bryk, & Congdon, 2000). The between-group ICCs for instruction support and student intrinsic motivation were .24

and .14 respectively, showing that over 10% of the total variance in these two variables was due to group differences. These results provided justification to conduct full-model HLM analyses that took group differences into consideration. However, neither the between-grade ICC nor the between-school ICC in the two dependent variables was more than .10, indicating that less than 10% of the total variance in the two outcome variables resided systematically between grades or schools. As these ICCs were considered trivial, we did not include grades and schools in our further HLM analyses.

Relationship between Teacher Motivation and Instructional Support

To examine whether teacher motivation was associated positively with instructional support perceived by students (Path A in Figure 1), we ran HLM analysis with instructional supports as the dependent variable and teacher intrinsic motivation as the predictor. In this analysis, the student-level model is presented by the equation:

$$\text{Instructional Support}_{ij} = \beta_{0j} + r_{ij},$$

where $\text{Instructional Support}_{ij}$ = instructional support perceived by student i in group j, β_{0j} = mean instructional support perceived by students in group j, and r_{ij} = residual of the equation. We did not include any predictor at this level.

The teacher-level model examining between-group differences in receiving instructional support is represented by the equation:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{Teacher Intrinsic Motivation})_j + u_{0j},$$

where β_{0j} = mean instructional support perceived by students in group j, γ_{00} = the intercept (grand mean) for instructional support, γ_{01} = the relation of teacher intrinsic motivation of group j to changes in instructional support perceived by students, and u_{0j} = residual of the equation. We expected that teacher intrinsic motivation would predict the mean instructional support perceived by students of each group. That is, γ_{01} would be positive and statistically significant.

The results showed that γ_{01} = .10 (*SE* = .05, *df* = 124, $p < .05$). Teacher motivation was indeed associated positively with instructional support perceived by students. That means Path A in Figure 1 was significant. When teachers reported higher intrinsic motivation in the project-based learning activity, their students tended to perceive more instructional support from them.

Relationship between Teacher and Student Intrinsic Motivation

To examine the relationship between teacher and student intrinsic motivation, we conducted HLM analysis with student intrinsic motivation as the dependent variable and teacher motivation as the predictor. In this analysis we did not include any predictor in the student-level model. The teacher-level model examining between-group differences in student intrinsic motivation is represented by the equation:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{Teacher Intrinsic Motivation})_j + u_{0j}.$$

We expected that teacher intrinsic motivation would predict the mean intrinsic motivation reported by students of each group. In other words, γ_{01} would be positive and statistically significant. This was the relationship between teacher and student intrinsic motivation without adjustment for instructional support. The results showed that γ_{01} =.17 (SE = .06, *df* = 124, $p < .01$). That means the higher the teachers reported intrinsic motivation in the project-based learning activity, the higher their students would report intrinsic motivation.

Relationships among Instructional Support, Teacher Intrinsic Motivation and Student Intrinsic Motivation

To investigate whether teacher intrinsic motivation and instructional support would predict student intrinsic motivation, we conducted a full-model HLM analysis of student intrinsic motivation with both teacher intrinsic motivation and instructional support as the predictors. In this analysis, the student-level model is presented by the

equation:

$$\text{Student Intrinsic Motivation}_{ij} = \beta_{0j} + \beta_{1j}\,(\text{Instructional Support}) + r_{ij}.$$

We expected that instructional support perceived by the students would be associated positively with intrinsic motivation reported by the students. That means β_{1j}. would be positive and statistically significant. This was Path B in Figure 1.

The teacher-level model examining between-group differences in student intrinsic motivation is represented by the equation:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{Teacher Intrinsic Motivation})_j + u_{0j}.$$

We expected that teacher intrinsic motivation would be associated positively with the mean intrinsic motivation reported by students of each group even after instructional support was controlled in the student-level model. That means γ_{01} would be positive and statistically significant. This was Path C in Figure 1.

The results showed that $\beta_{1j} = .73$ (*SE* = .04, *df* = 125, $p < .001$) and $\gamma_{01} = .10$ (*SE* = .04, *df* = 124, $p < .05$). When the students perceived more instructional support from their teachers, they reported higher intrinsic motivation in the project-based learning activity. In addition, teacher intrinsic motivation also made a unique contribution to student intrinsic motivation after instructional support was controlled. The model was able to explain substantial portions of the between-group variances in student intrinsic motivation [$\chi^2(125) = 130.13$, $p = .40$]. It explained 29.39% of the between-group variance in student intrinsic motivation (of the original 13.99% between-group variance found for the unconditional model). We determined this by subtracting the σ^2 value for the full HLM model ($\sigma^2 = .7811$) from the σ^2 value for the unconditional model ($\sigma^2 = 1.1063$) and then dividing by σ^2 for the unconditional model (see Raudenbush & Bryk, 2002).

Mediation Effect of Instructional Supports

According to Baron and Kenny (1986), there are three requirements for mediation. First, there must be a relation between the independent variable (i.e., teacher intrinsic motivation) and the mediator variable (i.e., instructional support). This was Path A in Figure 1 and the results indicated that this path was significant. Second, the mediator variable and the dependent variable (i.e. student motivation) must be related when analyses are adjusted for the independent variable. This was Path B in Figure 1 and the results indicated that this path was also significant. Third, the direct relationship between the independent variable and the dependent variable must be reduced once analyses are adjusted for the mediator variable. This was Path C in Figure 1 and the results indicated that the path coefficient was reduced from .17 to .10 once instructional support was included in the analysis. We conducted a Sobel test (Preacher & Hayes, 2004) to examine the mediation effect. The results showed that the mediation effect was significant statistically although the reduction was not great, $z = 1.99$, $p < .05$. Taken as a whole, the results showed that all three criteria for mediation were met. As all the paths in Figure 1 were significant, the partial mediation model was supported.

Discussion

The present study provides evidence of both direct and indirect relationships that account for the correspondence between teacher and student intrinsic motivation. The results supported the partial mediation model.

We found that teacher intrinsic motivation was associated positively with students' perceptions of instructional support (Path A). When teachers reported higher intrinsic motivation in project-based learning, their students would perceive more instructional support during the instructional process. We also found that students' perceptions of instructional support were associated positively with their intrinsic motivation. When students perceived more instructional support from their teachers, they would report

higher intrinsic motivation in project-based learning (Path B). In addition, we observed that the zero order correlation between teacher and student intrinsic motivation attenuated significantly when instructional support was taken into consideration. These results yield evidence for the role of instructional practices as a mediator between teacher and student intrinsic motivation.

The results of the present study also provided evidence for the direct association between teacher intrinsic motivation and student intrinsic motivation. Teacher intrinsic motivation had a unique contribution to student intrinsic motivation (Path C) even after students' perceptions of instructional support were controlled. Imitative learning or modeling might be operating in the process. Students might have picked up clues about the inherent enjoyment in project-based learning by observing their intrinsically motivated teachers. The correspondence between teacher and student motivation can thus be understood with reference to both instructional practices and modeling. These results support the argument that teacher and student intrinsic motivations are interconnected by multiple psychological processes.

Most of the previous research on teacher intrinsic motivation has focused on its relationship with the cognitive support provided by teachers, particularly on "controlling" versus "autonomy" supportive teaching practices (e.g., Deci et al., 1982; Garbarino, 1975; Pelletier et al., 2002). There is relatively little research on the relationship between teacher intrinsic motivation and other teaching practices that are also based on social-cognitive theories of motivation. These practices include presenting challenging work to students, integrating real-life significance with students' learning activities, stimulating students' curiosity in the learning tasks, acknowledging students' efforts, and providing useful feedback to students. In the present study, the instructional support being investigated included not only autonomy

support but also these practices. In addition, it also included affective support, an important catalyst of student motivation. The present study makes a unique contribution to the existing body of knowledge by demonstrating that these myriads of motivational practices are related to teacher and student intrinsic motivation. The results encourage researchers and educators to cast their eyes beyond autonomy support in the search of motivational instructional practices.

Project-based learning is a self-directed form of learning in which students work in small groups to do an in-depth investigation of a problem. The role of the teacher is not a knowledge provider but a facilitator. Unlike traditional teaching methods, such as direct instruction, project-based learning is student-centered instead of teacher-centered (Blumenfeld, et al., 1991; Hmelo-Silver, 2004). Students have to play an active role in the learning process. They must work collaboratively to seek out the answers for their questions. However, students may not always enjoy this challenging process. For example, in the study of Forrest, Kershaw, and Bott (1998), college students reported more negative than positive group experiences due to their perceptions of social loafing. Fortunately, experience in project-based learning is not necessarily always negative. The current research provides insight about the importance of teacher motivation and instructional practices in predicting student motivation in project-based learning. As suggested by Hmelo-Silver (2004), teachers can scaffold student learning by modeling and coaching. If teachers support the learning and collaboration processes, students will learn better and construct knowledge more effectively. Similarly, the study by Pedersen (2003) also indicated that students would have high intrinsic motivation in project-based learning if they had control over class activities, perceived great opportunity for collaboration and viewed the problems as challenging.

Limitations and Future Directions

Despite its contributions, the present study has some limitations. The cross-sectional data of correlational nature leave the causal status among variables ambiguous. For example, the positive association between teacher and student intrinsic motivation may indicate that intrinsically motivated teachers produce intrinsically motivated students. However, it is equally plausible to draw the converse conclusion: intrinsically motivated students elicit the intrinsic motivation of their teachers. There is evidence that teacher motivation is influenced by student motivation and behaviors. For example, Cobb and Foeller (1992) found that teachers had more enthusiasm when they expected their students to be motivated. Similarly, Stenlund (1995) found that teachers were discouraged when their students exhibited low motivation in the classroom. Perhaps the causality between teacher and student motivation is circular. For example, the longitudinal study of Skinner and Belmont (1993) showed reciprocal effects of student motivation on teacher behavior. Although initial teacher support predicted student motivation at a later time, students who exhibited higher motivation initially also received subsequently more support from their teachers. To determine the directionality of causality, future studies may consider the experimental manipulation of teacher or student motivation. Another possible direction is to employ longitudinal designs that allow time series analyses.

Another limitation of the present study lies in its measures. As all measures were self-reports either by teachers or students, the correspondence between teacher and student intrinsic motivation is open to alternative explanations other than those of instructional support and modeling. One such alternative explanation is expectancy formation. Wild, Enzle, and Hawkins (1992) illustrated this mechanism very well in an experiment. They assigned students randomly to either paid or volunteer teaching conditions. In the paid condition, the students were led to believe that their teacher was

extrinsically motivated by payment; whereas in the volunteer condition, they were led to believe that their teacher was an intrinsically motivated volunteer. Their results showed that students in the volunteer condition perceived their teacher as exhibiting greater enjoyment, enthusiasm, and innovation relative to those in the paid condition. They also enjoyed the lesson more, reported a more positive mood, and were more interested in further learning. It is noteworthy that the teacher in the experiment was blind to the conditions and had given the same standardized lesson to all participants. The results precluded the accounts of modeling as well as different instructional practices. They showed that, independent of instructional practices per se, merely perceiving a teacher as extrinsically motivated is sufficient to undermine students' task enjoyment and alter their perceptions of instructional practices. When students are aware that their teachers are extrinsically constrained, they will expect them to show little intrinsic interest in the activity and to be rigid in their teaching styles. They will also expect to find their learning experience boring. In the present study, instructional practices were measured by students' perceptions. The results of our HLM analyses might be indicative of a fourth model: expectancy formation. It was possible that students perceived more instructional support from their teachers when they observed that their teachers were intrinsically motivated. To exclude this alternative explanation, future studies need to obtain objective measures of instructional practices, such as reports from third-party observers.

The outcome variable of this study was restricted to student intrinsic motivation. No behavioral outcomes were included. Although student intrinsic motivation has been found to predict effective learning and high persistence (e.g. Grolnick & Ryan, 1987), this study could have contributed more to the existing body of knowledge if behavioral outcomes were included in the purview of investigation. Teachers of the 126 groups in

the present study adopted different assessment strategies. Thus, we were unable to use the grade assigned by the teachers as an indicator of student performance. Future studies may adopt objective assessment that is standardized across groups to measure student performance. Measures of task engagement and preference for challenge are also good behavioral indicators (Iyengar & Lepper, 1999).

The sample of the current study was small, including only Hong Kong secondary school teachers and students. To ascertain the generalizability of the present findings, future studies may include larger numbers of teachers and students with different cultural backgrounds. According to Markus and Kitayama (1991), people in the West emphasize individualistic conception of the self whereas people in the East emphasize connectedness and relationships. In view of the cross-cultural difference, it will be interesting to investigate whether the significant role of teacher motivation found in the current study is applicable to the West.

Conclusion

In conclusion, the present study has shown the important role of teacher motivation in student learning. Regardless of whether it is by the mechanism of instructional practices, modeling, or expectancy formation, teacher intrinsic motivation is associated positively with student intrinsic motivation. In the present climate of educational reform advocating project-based learning, the present study is a timely endeavor. The understanding of teacher and student intrinsic motivation in project-based learning is informative to educators who advocate for this new teaching approach. In addition, the results of this study have highlighted a promising area of research in the future, namely research on the antecedents of teacher intrinsic motivation. The present study revealed that teacher intrinsic motivation played an important role in the teachers' instructional practices as well as in the intrinsic motivation of their students. Insofar as the success of

project-based learning or any other new teaching approaches depends importantly on teacher intrinsic motivation, it is essential to understand what contributes to teacher intrinsic motivation in using new teaching approaches. Both personality and situational factors that promote teacher intrinsic motivation should be included in future investigations.

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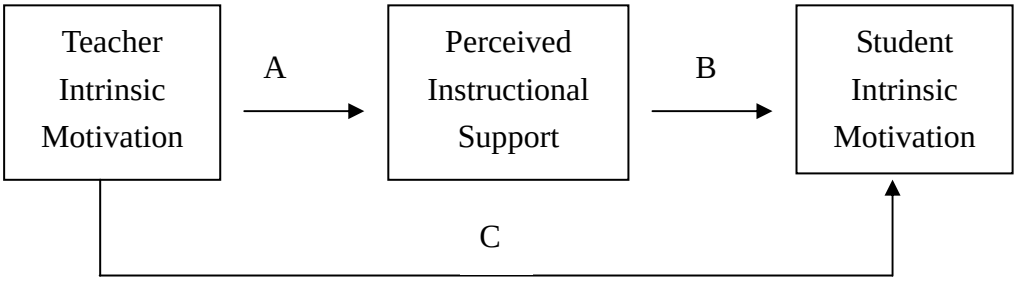

Figure 1

Path diagram indicating the relationships among teacher intrinsic motivation, perceived instructional support, and student intrinsic motivation.