Students' Intrinsic Motivation in Project-Based Learning Using an Asynchronous Discussion Platform

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The Project work (PW) initiative was introduced by the Ministry of Education, Singapore, to provide students with the opportunities to foster collaborative learning skills, to improve both oral and written communication, to practise creative and critical thinking skills, and to develop self-directed inquiry and life-long learning skills (Ministry of Education, 1999). Although PW has been introduced for a few years, there has not been much research done in the Singapore context, especially in terms of its effect on students' motivation. To fill the empirical gap, this study examined the extent in which PW, in an online learning classroom environment, promoted students' intrinsic motivation, as well as satisfied students' needs for competence, choice and relatedness. Specifically, data was collected from 7 classes of Secondary 2 students with the use of a modified version of the Intrinsic Motivation Inventory (IMI, McAuley,

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Duncan, & Tammen, 1989) to assess students' intrinsic motivation and their perceived choice, competence and relatedness, as well as their perceived value and effort in the PW context and in their normal mathematics and/or science lessons. Comparisons were made to establish whether there was any significant difference in terms of the students' experiences in the different learning contexts.

Key words: project work, motivation, self-determination theory

The Ministry of Education, Singapore, launched the Project Work (PW) initiative in the year 2000 to better prepare its students for the challenges of the 21st century and to achieve the country's vision of "Thinking Schools, Learning Nation" (TSLN). The aims of PW are to provide students with the opportunities to (a) foster collaborative learning skills, (b) improve both oral and written communication, (c) practise creative and critical thinking skills, and (d) develop self-directed inquiry and life-long learning skills (Ministry of Education, 1999).

In the Singapore context, PW, more commonly known as Project-based learning in other countries, is an in-depth assignment that provides students with opportunities to explore the inter-relationships and inter-connectedness of subject-specific knowledge (Quek et al., 2006). It focuses on the application of knowledge and skills from two to three disciplines that are linked together by either a theme or a problem. It is investigative in nature and the theme generally centres on real-world issues that is worthy of students' attention and effort. Students work collaboratively to select their own project idea, plan their own schedule, execute their plan and construct their own learning. The role of the teacher is that of a facilitator or a resource person, rather than that of an instructor who transmits information and organises the activities. At the end of the PW, students are expected to do an oral presentation as a group, and to come up with a final product, e.g., an artefact, a report, a presentation or a performance. The educational advantages of PW have resulted in the wide-spread implementation of PW in Singapore schools, from primary to junior college.

Since the implementation of PW, a number of studies have looked into the learning outcomes of PW and students' perceptions of PW at junior college, secondary and primary levels (e.g., S. C. A. Chang, 2004; Lee, 2001; Mohamed Razali, 2003; Quek & Wong, 2002). For instance, Chang and Chang (2003) found that most of the junior college students surveyed ($N = 567$) believed that their engagement in PW had improved their communication and collaboration skills. They also contended that it had enhanced their thinking and problem-solving skills. Likewise, Tan's (2002) study of secondary school boys ($N = 70$) revealed that the experience of PW had positive effects on teamwork and communication skills, problem-solving and thinking skills, as well as self-regulation skills. Chua's (2004) study of Primary 5 students ($N = 120$) reiterated that the students had positive perceptions of their attainment in the four main domains of cooperation, knowledge application, communication and independent learning, whilst Wong's (2001) study of primary school students ($N = 171$) affirmed that the students had benefited from PW. Specifically, the study revealed that the students had learned to "cooperate" and "respect each others' views" (p. 81), and that the project task supported the use of thinking skills such as classifying and comparing. There was also evidence to suggest that the students were beginning to exhibit self-directed inquiry when they looked for help in their project tasks.

In essence, there is a general consensus that the objectives of PW are being met and that students have benefited, be it cognitively or socially, from their engagement in PW. Nonetheless, much less is known about the effect of PW on students' affect or motivation. Considering that PW is a non-examinable subject, it would be interesting to know how students' level of motivation in PW compares with their levels of motivation in other examinable subjects. Since there are no formal grades given for PW in the Singapore context, it is possible that students' level of motivation may be lower in PW as compared to other examinable subjects, even though they may have benefited from their PW experience.

Self-determination Theory

The self-determination theory (SDT, Deci & Ryan, 1985, 1991) is one of the most comprehensive and empirically supported theories of motivation today (Pintrich & Shunk, 2002). It is a key explanatory system for the understanding of volitional behaviours (Deci & Ryan, 1985, 1991).

According to the SDT, human beings have three innate psychological needs—needs for choice (autonomy), competence and relatedness that are crucial for the development of the self in terms of growth and personal well-being. The need for choice is defined as the need to feel ownership of one's behaviour (deCharms, 1968). The need for competence refers to the need that individuals want to produce desired outcomes and to experience mastery and effectiveness when dealing with their environment (Harter, 1978). The need for relatedness pertains to the feeling that one is close to and belongs to a social group (Ryan, 1993). The SDT model proposes that all individuals desire to feel autonomous, competent and related and that if these three needs are satisfied, intrinsic motivation for doing the activity will increase. In contrast, if the three needs are not supported, intrinsic motivation will decrease. It is important to note, however, that it is how these dimensions are perceived that determines whether the positive effect will occur (Daniels & Perry, 2003). In other words, teachers may report that they made efforts to provide choices, and this may even appear true to independent observers, but if students do not interpret the efforts positively, their intrinsic motivation will not be enhanced. The findings from recent studies provide strong support for the SDT. In essence, there is a consensus that students were more motivated, placed a higher value in learning, and were more meaningfully engaged in schoolwork and activities when they perceived that their teachers incorporated practices that addressed their needs (e.g., Daniels, Kalkman, & McCombs, 2001; Valeski & Stipek, 2001).

Project-based Learning

Project-based learning is a model that organises learning around projects. The term "projects" refers to "long-term, problem-focused, and meaningful

activities that bring together ideas and principles from a number of subject areas or disciplines" (Goodrich, Hatch, Wiatrowski, & Unger, 1995, p. viii). For PW in Singapore, Goodrich et al.'s (1995) concept of "projects" is extended to include aspects of communication and collaboration because students work in groups of four or five in each project task. In this sense, PW is essentially a form of cooperative learning. It works on the basic assumption that when group members are linked together in such a way that they cannot succeed unless the group succeeds, they will help each other to ensure that the task is completed and the group's goal achieved (Deutsch, 1949). They do this by providing help and assistance with the task, sharing resources, and encouraging each other (Gilles, 2004).

Students' Motivation and Project-based Learning

Several studies have reported that cooperative learning has positive effects on students' level of motivation (e.g., Gardner, Mason, & Matyas, 1989; Hartman, DeCicco, & Griffin, 1994). In fact, many have argued that the procedures of cooperative learning are designed to enhance intrinsic motivation because of its emphasis on a high level of autonomy in deciding the "what" and "how" of projects, as well as the chance to assist and work closely with their peers (e.g., Ames, 1992; Ryan, Connell, & Grolnick, 1992; Shachar & Sharan, 1994). Similarly, others have posited that project-based learning designs, because of their emphasis on student autonomy, collaborative learning, and assessment based on authentic performances, are seen to maximise students' orientation toward learning and mastery (Thomas, 2000). In addition, project tasks that incorporate features such as variety, challenge and student choice are also thought to promote students' interest and perceived value (Blumenfeld et al., 1991). Nonetheless, the majority of studies conducted on cooperative learning or project-based learning and motivation were carried out with students in primary schools, and none of the studies was conducted in the Singapore PW context. To fill the empirical gap, this study looked at students' intrinsic motivation and their perceived choice, competence and relatedness in the PW context and

in their normal mathematics and/or science lessons. Comparisons were then made to establish whether there was any significant difference in terms of the students' experiences in the different contexts. In order to have a more comprehensive picture, the study also examined students' perceived value of PW and the two examinable subjects, as well as the amount of effort students were willing to put into PW and the two examinable subjects. Specifically, the study attempted to answer the following research questions:

1. Are perceived choice, competence and relatedness significant predictors of students' motivation in PW?

2. Is there any significant difference between students' motivation and their perceived choice, competence and relatedness in PW and mathematics, or in PW and science?

3. Is there any significant difference between students' perceived value of PW and mathematics, or PW and science?

4. Is there any significant difference between the amount of effort students were willing to ascribe to PW and mathematics, or PW and science?

Method

Sample

The participants consisted of 254 Secondary 2 students from 7 schools who took part in a large scale research project entitled "Student-centred Learning in the context of PW". All 7 schools are typical government funded co-educational schools, randomly selected from different parts of Singapore. The students were of average ability.

The data used in this study was collected as part of a 2-year funded project on teachers' and students' perceptions of project work in an on-line computer supported environment. The aims of the project were to examine PW teachers' pedagogical knowledge, skills and experience as collaborators, designers and facilitators of PW, as well as students' experience and perceptions of PW, and their concerns at various stages of the PW process.

Procedure

At the beginning of the academic year, students who were involved in the research project were grouped into 68 project groups with the help of their PW teachers. Each PW group consisted of between 4 to 6 students from either two or three schools. The students were taught how to use the Knowledge Community platform and they did most of their project discussion with their counterparts from the other schools in the asynchronous online discussion environment. The main advantage of using the platform was that it captured the students' discussions, thus making their thinking "visible" to their PW teachers.

The duration of PW was 10 weeks. Two periods ($1\frac{1}{4}$ hours) were allocated per week for PW, which were used by the PW teachers to facilitate students' learning and teach them just-in-time skills. Time was also set aside for the students to log on and discuss with their counterparts from the other schools. Within the 10-week period, the students had two face-to-face meetings. The first time was to finalise their project proposal, and the second time was to finalise the details of their presentations and products. Both meetings were facilitated by their PW teachers and the researchers who were involved in the research project.

At the end of the study, the students were asked to fill in a questionnaire to assess their intrinsic motivation in PW. On a separate occasion, half the students in each of the participating classes were randomly selected to fill in a questionnaire to assess their intrinsic motivation in their mathematics lessons, while the other half filled in a corresponding questionnaire for their science lessons. The only exception was one class which had students who filled in the questionnaires for both mathematics and science lessons on two separate occasions. After the elimination of cases with clear response bias, the final sample consisted of 254 students who had responded to the PW questionnaire. Amongst the 254 students, 120 had responded to both the PW and mathematics questionnaires, and 111 had responded to both the PW and science questionnaires.

Measures

The Intrinsic Motivation Inventory (IMI, McAuley et al., 1989) was used to assess students' interest/enjoyment, and their perceived value, effort, choice, competence and relatedness. Answers for the items were given on a 7-point scale ranging from 1 (not true at all) to 7 (very true). The items were modified slightly to fit the different contexts, that is, PW, mathematics and science. Although the questionnaire is called the Intrinsic Motivation Inventory, the interest/enjoyment subscale is considered the self-report measure of intrinsic motivation as it is the only subscale that assesses intrinsic motivation per se (McAuley et al., 1989).

The IMI is an established questionnaire which has been used extensively in studies on intrinsic motivation and self-regulation (e.g., Deci, Eghrari, Patrick, & Leone, 1994; Ryan, Koestner, & Deci, 1991). The IMI consists of varied numbers of items from these subscales, all of which have been shown to be factor analytically coherent and stable across a variety of tasks, conditions, and settings. In addition, McAuley et al. (1989) have also found strong support for its validity.

With respect to the current study, all the interest/enjoyment (7 items), value (5 items), effort (5 items), choice (7 items), competence (6 items) and relatedness (8 items) subscales had high internal consistencies when used in the PW context, as well as in the mathematics and science contexts. Specifically, the internal reliability estimates of the subscales were as follows: interest/enjoyment alphas = .85 to .90, value alphas = .90 to .94, effort alphas = .73 to .82, choice alphas = .71 to .78, competence alphas = .79 to . 90 and relatedness alphas = .83 to .87.

Results

To answer research question (1), a stepwise multiple linear regression was conducted to establish whether students' perceived choice, competence and relatedness were significant predictors of their intrinsic motivation in the PW context (see Table 1). The stepwise regression method was preferred

over the fixed-order regression method because it uses empirical procedures to determine the order of entry of predictive variables into the regression model.

Table 1   Stepwise Regression on the Intrinsic Motivation Scale ($N = 254$)

Stepwise	Predictor	R^2	ΔR^2	F Change	ß
1	Competence	0.244*	0.244*	80.41	0.494*
1	Competence	0.365*	0.121*	71.41	0.422*
2	Choice				0.356*
1	Competence	0.418*	0.053*	59.24	0.349*
2	Choice				0.269*
3	Relatedness				0.261*

*$p < 0.001$

The regression result affirmed that perceived choice, competence and relatedness were all significant predictors of students' intrinsic motivation in the PW context. They accounted for 41.8% variance of students' intrinsic motivation. In particular, competence was the most prominent predictor. It was able to account for 24.4% of the variance of students' motivation.

To answer research questions (2) to (4), a series of one-way repeated-measures ANOVAs were conducted using the General Linear Model Repeated-Measures procedure to establish within-subjects differences. Specifically, for research question (2), two one-way repeated measures ANOVA were carried out for two different subgroups of students to examine potential differences between contexts (within-subjects factors) using intrinsic motivation, choice, competence and relatedness scores as the dependent variables.

Table 2   Descriptive Statistics of the Two Subgroups of Students in Different Contexts

	Subgroup 1 ($n = 118$)				Subgroup 2 ($n = 110$)			
	PW		Mathematics		PW		Science	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Intrinsic motivation	3.94	1.27	4.89	1.23	3.84	1.17	4.65	1.26
Choice	4.25	1.09	4.70	0.91	4.06	1.12	4.32	1.00
Competence	3.68	1.11	3.85	1.31	3.55	1.07	3.97	1.13
Relatedness	4.51	1.20	5.03	0.99	4.28	1.22	4.80	1.12

The students' responses were largely neutral to positive for PW, as well as for mathematics and science contexts. The mean scores ranged from 3.55 to 4.51 for PW, 3.85 to 5.03 for mathematics, and 3.97 to 4.80 for science. Specifically, the results of the first one-way repeated-measures ANOVA (subgroup 1) showed that the main effect of context was significant (Wilk's $\Lambda = .65$, $F(4,114) = 15.47$, $p < 0.001$). In addition, the within-subjects contrasts established that the students' intrinsic motivation $(F(1,117) = 44.96$, $p < 0.001)$, choice $(F(1,117) = 14.68$, $p < 0.001)$ and relatedness $(F(1,117) = 20.41$, $p < 0.001)$ were significantly lower in the PW context as compared to the mathematics context.

Likewise, the results of the second one-way repeated measures ANOVA (subgroup 2) showed that the main effect of context was significant (Wilk's $\Lambda = .70$, $F(4,106) = 11.25$, $p < 0.001)$. In addition, the within-subjects contrasts established that the students' intrinsic motivation $(F(1,109) = 27.39$, $p < 0.001)$, competence $(F(1,109) = 12.02$, $p < 0.005)$ and relatedness $(F(1,109) = 20.00$, $p < 0.001)$ were significantly lower in the PW context as compared to the science context.

With regard to research questions (3) and (4), two one-way repeated measures ANOVAs were carried for two different subgroups of students to examine potential differences between contexts (within-subjects factors) using value and effort as the dependent variables. The descriptive statistics are shown in Table 3.

The students' responses were largely positive for PW, as well as for mathematics and science contexts. Nonetheless, the results of the first one-way repeated-measures ANOVA (subgroup 1) showed that the main effect of context was significant (Wilk's $\Lambda = .69$, $F(2,118) = 26.87$, $p < 0.001)$. In

Table 3   Descriptive Statistics of the Two Subgroups of Students in Different Contexts

| | Subgroup 1 ($n = 120$) | | | | Subgroup 2 ($n = 111$) | | | |
| | PW | | Mathematics | | PW | | Science | |
	M	SD	M	SD	M	SD	M	SD
Value	4.25	1.48	5.42	1.13	4.23	1.40	5.17	1.24
Effort	4.68	1.15	5.04	1.04	4.51	1.14	4.87	1.06

addition, the within-subjects contrasts established that perceived value $(F(1,119) = 54.03, p < 0.001)$ and effort $(F(1,119) = 8.90, p < 0.005)$ were significantly lower in the PW context as compared to the mathematics context.

Likewise, the results of the second one-way repeated-measures ANOVA (subgroup 2) showed that the main effect of context was significant (Wilk's $\Lambda = .72, F(2,109) = 21.60, p < 0.001$). In addition, the within-subjects contrasts established that perceived value $(F(1,110) = 40.35, p < 0.001)$ and effort $(F(1,110) = 8.83, p < 0.005)$ were significantly lower in the PW context as compared to the science context.

Discussion

Predictors of Students' Intrinsic Motivation in Project Work

The regression finding provides support for the self-determination framework and is consistent with the findings of other earlier studies (e.g., Daniels et al., 2001; Valeski & Stipek, 2001). Essentially, it suggests that if educators and teachers are keen to enhance the intrinsic motivation of their students, in PW or otherwise, they should try to provide social contexts that satisfy the three basic needs for competence, choice and relatedness.

In the context of PW, teachers can try to fulfil students' need for competence by giving positive feedback, promoting moderately difficult project tasks or by promoting mastery goals (Arends, 2004; Kilpatrick, Hebert, & Jacobsen, 2002). To satisfy students' need for autonomy, one of the most basic things that teachers can do is to provide the rationale for doing PW. Instead of informing the students that PW is prescribed by the Ministry of Education and is part of the curriculum, teachers should explain to the students the aims and objectives of PW, especially in terms of it being an authentic form of learning which will equip them with valuable skills to meet the demands of the workplace or the real world. Even if the PW theme does not produce the intrinsic rewards of excitement, pleasure or challenge, knowledge of its benefits may promote a sense of purpose for doing it. In

addition, teachers can also promote autonomy by providing choices. Giving students a choice supports the development of satisfaction and autonomy, and reduces the perception of coercion. It also increases the chance that more students will be optimally challenged (Arends, 2004).

It is perhaps not surprising that students are more willing to work on their projects if they get along well as a team. The development of social relationships tends to support the development of social satisfaction, enjoyment and relatedness, which in turn fosters greater motivation and commitment to the task at hand (Kilpatrick et al., 2002). Nonetheless, PW teachers should not take for granted that such social bonds would develop naturally and groups would work together happily. Students "do not know instinctively how to interact effectively with others. Nor do interpersonal and group skills magically appear when they are needed" (Johnson & Johnson, 1989, p. 30). As such, it is crucial that PW teachers give clear instructions to the students about their roles (e.g., leader, recorder, and observer) and responsibilities in the team.

Students' Perceptions in Different Contexts
With regard to the one-way repeated measures ANOVA, the results established that there were significant differences between students' motivation, perceived level of choice, competence and relatedness in the PW context and in their mathematics or science lessons. Since no other reviewed study has compared students' experiences in PW and in science or mathematics lessons, it is not known whether the results are typical. Although the results seem to go against intuition, they are not totally incomprehensible. Part of the reason could stem from the fact that PW is relatively new in Singapore so students are still grappling with the "what" and "how" of PW. Perhaps given more time and training, students may be more receptive towards PW.

It will be recalled that in the current study, PW was conducted using an asynchronous discussion platform instead of the traditional face-to-face discussion between group members. To a certain extent, it is possible that

the use of the discussion platform could have contributed directly to the students' feeling of less personal involvement and relatedness. Considering that relatedness was a significant predictor of students' intrinsic motivation, albeit not the most dominant one, PW teachers may want to think of ways to build a "social context" that supports relatedness in the virtual world.

It is noteworthy that the students in the current study felt that they had less autonomy when doing PW as compared to their mathematics lessons. The reason for the finding is not clear. The general assumption is that PW, like any other forms of cooperative learning, should give students more autonomy since they need to decide the "what" and "how" of their projects (Ames, 1992). The students in this study obviously did not share the sentiments. In view of the current findings, PW teachers may want to reflect on the way they facilitate their PW lessons. They need to check themselves to make sure that they are not being overly prescriptive in their enthusiasm to guide the students.

In light of the fact that perceived competence was the most dominant predictor of students' intrinsic motivation, it is a concern that the students had significantly lower level of perceived competence in the PW context as compared to their science lessons. The reason for the finding is again not apparent. In the current study, all the students went through a training session to familiarise them with the Knowledge Community platform. There was no evidence to suggest that any of them had difficulty reading or posting messages, so it is unlikely that the perceived lack of competence was linked to the use of the discussion forum per se. Since PW was relatively new to the students, it is possible that their perceived lack of competence could reflect a more generic sense of anxiety or helplessness when faced with an unfamiliar task. It is also plausible that the project tasks that were designed by the PW teachers may have been too difficult for them to handle.

It will be recalled that there were significant differences between students' perceived value and effort in the PW context as compared to their mathematics and/or science contexts. Considering that people internalise and become self-regulated with respect to activities that they experience as

useful or valuable for themselves (Deci et al., 1994), it is a concern that the students did not perceive PW to be valuable to them. Although the results have not been documented, they are not totally surprising. Since PW is a non-examinable subject, it is conceivable that students may be less willing to put in time and effort into their projects when they can use the time to prepare for tests and examinations that will contribute to their overall grades. A knee-jerk reaction to the findings would be to call for PW to be included as an examinable subject. At a superficial level, the suggestion may address the issue. However, if we emphasise merely on grades or extrinsic rewards in learning, we run the risk of undermining students' intrinsic motivation (Arends, 2004). Although it is difficult to address the issue completely, a good starting point is to strive to change students' perceived value of PW, perhaps by ensuring that all the students are aware, if not convinced, that PW provides them with the opportunities to learn collaborative skills, to improve their oral and written communication skills, to practise creative and critical thinking skills, and to develop self-directed inquiry and life-long learning skills that will prepare them to meet the challenges of the 21st century.

Finally, it has to be reiterated that in the current study, PW was conducted using an asynchronous discussion platform. Although the PW process that the students went through was the same as that of traditional PW using face-to-face discussion, we cannot preclude the fact that the experience and/ or challenges of using the computer may have moderated the students' experience of PW. Thus, to have a clearer picture of students' perception of PW in the Singapore context, there is a need to replicate the study in traditional PW classrooms. In future studies, it would also be useful to look at teachers' perspective of PW as well, possibly in terms of their perceptions of PW and the way they implement this new instructional practice; both of which should have critical impact on students' perception and experience of PW. A more complete study would also entail looking at students' motivation from different dimensions, such as their achievement motivation, attributions and/or goal orientations.

Concluding Remarks

Students who are intrinsically motivated for doing schoolwork are "more likely to stay in school, to achieve, to evidence conceptual understanding, and to be well adjusted" than students who are more extrinsically motivated (Deci, Vallerand, Pelletier, & Ryan, 1991, p. 332). In this view, if policy makers and educators in Singapore are genuinely striving to achieve the PW objectives, particularly, that of developing students' self-directed inquiry and life-long learning skills, then there is an urgent need for them to look into what teachers can do to change students' perceptions of PW and to refine the processes of PW teaching and learning. At the school level, schools should seriously consider what they can do to provide social contexts that will enhance students' intrinsic motivation by supporting their needs for competence, choice and relatedness.

Acknowledgements

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