

Assessing Secondary Students' Reflective Thinking in Project Work

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Educators in Singapore are encouraged to re-examine their teaching practices for improved student engagement. This has led to the exploration and creation of curriculum and assessment initiatives by schools to harness diverse learner strengths and other less tangible but important qualities such as character and values. One such initiative in a particular school builds on an existing Project Work Programme (PWP) to nurture the reflective and meta-cognitive learning abilities of students. An exploratory study was conducted to evaluate the assessment and grading procedures used in this revised PWP to measure the extent of reflective thinking in 196 Secondary One (Grade 7) students. In addition, the relationship between students' reflective thinking and their methods of learning was investigated. These findings were compared with the data from a control group comprising 365 PWP students from two comparable secondary schools. This paper reports on the findings from this study and highlights some special challenges involved in clarifying, validating and operationalising concepts such as reflection for the purpose of formative assessment.

Introduction

A call "to teach less, so that students can learn more" has challenged teachers in Singapore schools to improve on the quality of their interactions with students so as to better engage them in their learning and achieve the outcomes of education (Lee, 2004). The underpinning message is that traditional teaching methods may no longer be sufficient to meet students' learning needs and prepare them for the 21st century (Ng, 2008; Tharman, 2005). Moving ahead, schools are encouraged to sharpen their focus on developing diverse learner strengths and other less tangible but important qualities such as character and values. Supported by the Ministry of Education (MOE), this "ground-up" approach towards transforming learning has led schools to explore many curriculum initiatives (MOE, 2008; Tharman, 2006).

One such initiative in a typical secondary school focuses on nurturing the reflective and meta-cognitive learning abilities of Grade 7 students. Designed by a team of teachers, the initiative was to be an enhancement of the Project Work Programme (PWP) that is implemented in secondary schools since 2001. PWP was considered for its potential to provide students with rich inductive and experiential learning possibilities (MOE, 2009). Students' learning could be greatly enhanced when reflective abilities are elicited during these experiences (Fletcher, 2005; Moon, 2004).

Results from the inaugural first-year run of the revised PWP in 2006 with Secondary One Express students have been promising, providing some evidence that students' participation has helped develop their reflection skills (Lim-Ng, 2007). This paper reports on the findings of a later study to evaluate the assessment and grading

procedures used to measure reflective thinking in students. As an ancillary to the main study, the relationship between students’ reflective thinking and their methods of learning was also investigated and insights from the findings will be shared.

Revised Project Work Programme

Participating students in the revised PWP (rPWP) take on the role of researchers to study classroom, school and community-related issues with the view of improving the outcomes. The type of teaching and learning activities is guided by a cyclical process which consists of three steps: (a) plan – students work in groups of three or four to identify an issue or area of interest which they hope to make a positive contribution in; (b) act and observe – relevant data is collected through active participation; and (c) reflect – interpret data to make changes. These are briefly summarised in Table 1.

Table 1. Main teaching activities in the 28-week rPWP

Phase	Duration	Teaching Activities
Plan	Week 1 – Week 4 (Jan – May)	Observe environment and understand desired educational outcomes; Group formation and conflict management; Identify issue or problem for study; Pose questions for research; Apply for funds; Review literature and understand research ethics; Data collection techniques; Write project proposal; Prepare for “Project Selling Day”
Act & Observe	Week 15 – Week 24 (July – mid-Sept)	Implement project; Gather and analyse data; Prepare for class presentation and feedback sessions
Reflect and possible 2 nd cycle	Week 25 – Week 28 (mid-Sept – mid-Oct)	Reflect on project; Oral presentation of project to class; Submit group evaluation report; Conduct a second cycle (if possible)

Learning outcomes targeted for these Grade 7 students include students’ reflective skills, confidence, motivation and a sense of ownership and their contribution to impact upon the community. Students’ self-reflection is the linchpin of the revised PWP.

Reflective Thinking and Students’ Approach to Learning

In the rPWP, a reflective student is one who *systematically and critically inquires* about how his thinking (values and knowledge) and actions (skills) may impact on other people’s lives and perspectives. He is pro-active in using his reflective skills in identifying issues or problems in the communities that he belongs to and also seeks out improvement or solutions to the problem(s) encountered. Conversely, feedback from the communities can trigger his further reflection.

This definition identifies three desired attributes of reflective thinking: quality learning (Tan, 2004; Boud et al., 1985), abilities to undertake appropriate actions to resolve issues (Moon, 1999) and abilities to modify thinking for future actions (Biggs, 1999). Its theoretical underpinning is based on Jack Meizrow's (2000, 1991) reflection construct. Meizrow's theory on transformative learning was adopted because its underlying antecedents, definitional premises and processes, as separately identified by Rogers (2001, pg. 39), are in congruence with the rPWP. Refer to Appendix 1.

Transformative learning, along with the work of other researchers, have suggested that 'reflection can be both noun and verb, both product and process' (Brockbank and McGill, 2007, pg. 193). Teaching activities are thus designed to encourage and document rPWP students' participation and developmental growth in reflective thinking (Lim-Ng, 2007). Concurrently, the assessment strategy measures students' attainment of reflective thinking both in terms of the results and the journey (getting to key end-points). Towards this end, all teaching activities have a reflective learning component and these are assessed by teachers.

As part of this study, the Students' Approach to Learning theory was considered. Close association between reflective learning and learning approaches have been reported by researchers such as Leung & Kember (2003) and Phan (2006). Evidence of such similar relationships in this study could serve to provide valuable insights into the value and validity of the reflection construct and assessment schemes used.

Framework of the Main Study

A study framework drawn up for the 28-week programme (see Figure 1) specified the various methods for assessing and grading students' reflective thinking by teachers. "Process" type of assessment methods include students' self-reflection logs for capturing individual thoughts and experiences, learning worksheets for the whole team as well as observation logs recorded by teachers during lessons and consultation sessions. Products such as students' projects and group presentations also have reflective thinking assessment components. To capture students' self assessment of their reflective thinking and learning approaches skills, a survey with two questionnaires was conducted. The Reflection Questionnaire and the Learning Process Questionnaire were administered towards the end of the rPWP.

Method

Participants - The group in the main study comprised 196 rPWP students from five Secondary One (Grade 7) classes, of which 101 were females and 95 were males. The typical age of these students was 13 years and they had sat the Primary School Leaving Examination (PSLE) in Singapore the year before. Their overall results were reported as PSLE Aggregate Scores. The mean PSLE Aggregate Score of these students was 215, which was above the national mean. Two teachers were assigned to each rPWP class.

As part of an ancillary study, PWP Secondary One students from two other schools (Schools A and B) were invited to participate in the survey with the two questionnaires. Both schools were selected because their students had similar academic attainment and

background profiles. School A had modified the MOE-originated PWP with Problem-Based Learning (PBL) teaching elements while school B used the original PWP teaching package. The questionnaires were administered in the same two weeks of the academic terms as rPWP students. See Table 2.

Measures - All activities in the rPWP were graded using generic band descriptors designed by the teachers. These band descriptors specify levels of attainment in various performance outcomes including one on reflective thinking. For ease of recording, teachers reported an overall mark for every activity. At the end of the programme, marks from all activities were added up to form a summative Teacher-Awarded Score (TAS) for a student’s overall 28-week performance.

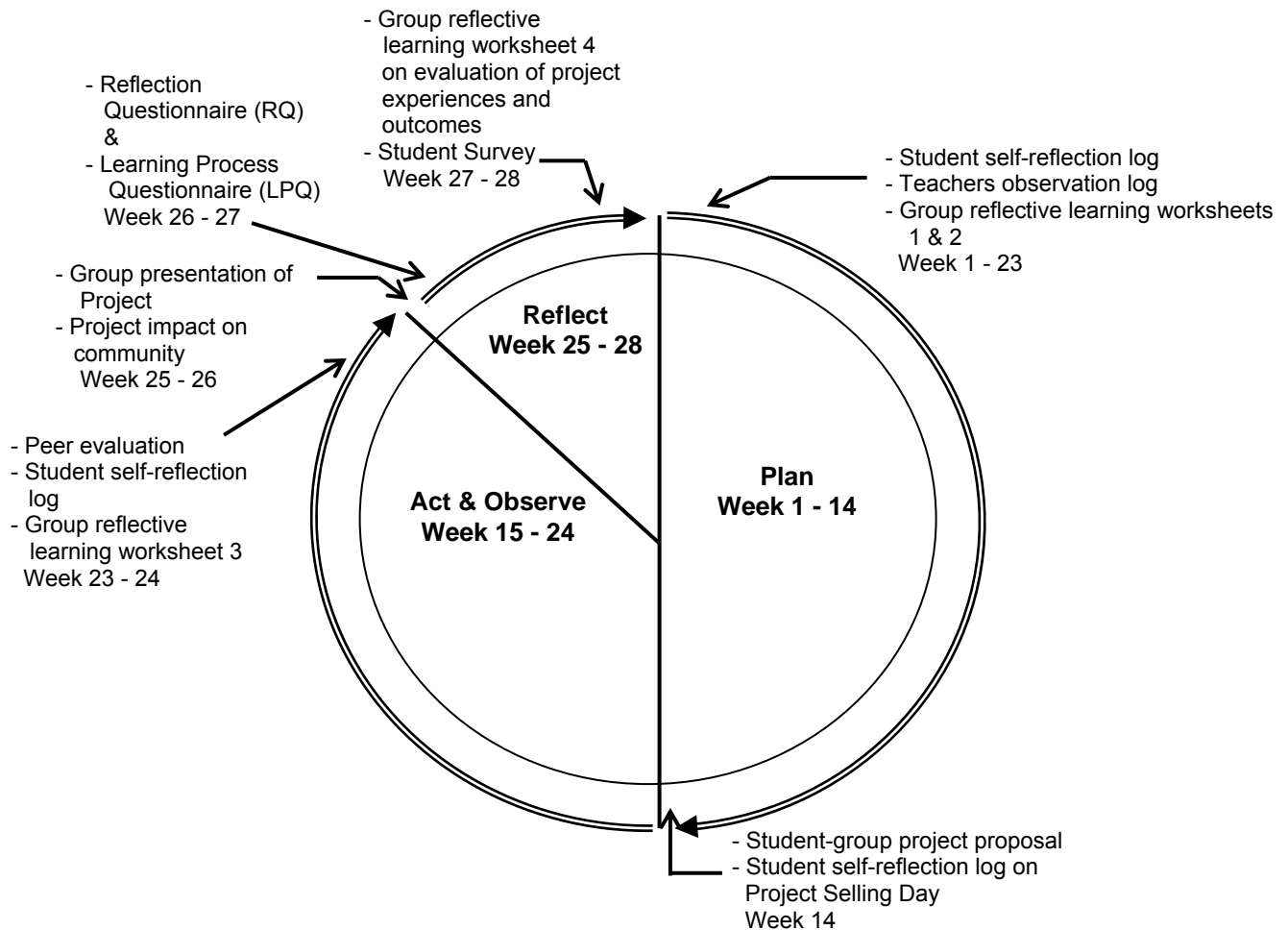


Figure 1. A study framework of the 28-week PWP

The Reflection Questionnaire (RQ) developed by Kember et al. (2000) was based on Mezirow’s (1991) theory on transformative learning which proposed two categories of reflective and non-reflective actions. In Kember’s instrument, four levels of reflective and non-reflective thinking are delineated – Habitual Action (HA), Understanding (U), Reflection (R) and Critical Reflection (CR). Table 3 provides a summary of the relationship between Mezirow’s categories and Kember’s scales of reflection actions/thinking. The 16-item RQ instrument used a five-point Likert-type

scale ranging from “definitely agree” to “definitely disagree” to elicit responses from the respondents.

Table 2. Details of two schools in the ancillary study

School	Type of PWP	Mean PSLE Aggregate Score	Male	Female	Total
A	PBL + PWP	211	102	79	181
B	PWP	212	101	83	184
Total			203	162	365

Table 3. Scales in the RQ and categories of non-reflective and reflective actions

Type of Action (Mezirow, 1991)	Scale (Kember et al., 2000)	Definition (Adapted from Leung & Kember, 2003)
Non-Reflective: Habitual action	Habitual Action (HA)	HA is that which has been learnt before and through frequent use becomes an activity which is performed automatically or with little conscious thought. E.g. Dealing with similar problems frequently; handling routine work.
Non-Reflective: Thoughtful Action	Understanding (U)* *narrowed meaning of thoughtful action adopted here	U is understanding without relating to other situations. E.g. Student reaching an understanding of a concept without reflecting upon its significance in personal or practical situations.
Reflective: Reflection on Content and/or Process	Reflection (R)	R is active, persistent and careful consideration of any beliefs or supposed form of knowledge in the light of the grounds that support it and the further conclusion to which it tends. E.g. Student assessing whether his methods of solving an Algebra problem has so far been dependable so as to improve his future performance with similar problems.
Reflective: Reflection on Premise	Critical Reflection (CR)	CR is a higher level of reflective thinking that involves participants becoming aware of why they perceive, think, feel or act as they do. E.g. Student questioning the merit and functional relevance of the need to solve Algebra problems; these questioning may lead him to consider its impact on choices or decisions to make (e.g. studying a Mathematics course, etc.)

The Learning Process Questionnaire (LPQ) is a revised two-factor version with deep and surface approach scales (Kember, Biggs & Leung, 2004) designed for use with secondary school students. Learners adopting deep and surface approaches towards learning are characterised by their displayed intentions and use of processes in approaching the learning tasks (Biggs, 1987; Ramsden and Entwistle, 1981; Marton and Säljö, 1976). Deep approach (DA) adopters are intrinsically motivated to attain in-depth

understanding of materials and link this to prior knowledge and personal experience. On the other hand, surface approach (SA) adopters learn with the intention of reproducing information without any further analysis. They largely fail to grasp the underlying principles of the learning materials. Like the RQ, the 22-item LPQ used a five-point Likert-like scale ranging from “always or almost always true of me” to “never or only rarely true of me”. Leung and Kember (2003) had reported that some of the scales of an earlier version of the LPQ correlated significantly with those of the RQ. This suggests that students who adopt either of the two learning approaches might be exhibiting specific reflective thinking skills.

Both instruments were piloted with a previous batch of five classes of Secondary One students (n=195) in the context of the rPWP. The pilot study was useful as a check on the quality of the instrument as well as in identifying potential problems that could arise owing to the phrasing of the items. A factor analysis of the RQ instrument during the pilot run (Lim-Ng, 2007) revealed a three-factor instead of a four-factor measure as in Kember’s (2000) work; items that fall within the Critical Reflection and Reflection scales were grouped as one (CRnR). This adapted version of the instrument was used in the main study. As in Kember’s (2004) work, the factor analysis of the LPQ with piloted data suggested a two-factor structure as well.

Procedure - The 28-week rPWP was implemented with the selected sample of Secondary One students from January to end-September. In the main study, the Teacher Awarded Scores (TAS) collated at the end of the programme along with students’ self-reported assessment of their reflection skills and learning approaches were analysed for possible associations. In the ancillary study, students’ responses to the two questionnaires were compared across three schools.

Results and Findings

Main Study – The scores of the revised RQ showed satisfactory reliability coefficients of 0.80 for the CRnR scale and 0.67 for the U scale. A lower reliability coefficient of 0.49 was obtained for the HA scale. In the LPQ instrument, reliabilities of 0.84 and 0.6 were obtained for the DA and SA scales respectively. The trend observed in these reliability coefficients was largely consistent with those reported by Kember et al. (2000). See Table 4. The range of scores for CRnR is from 7 to 35, indicating low to high level of critical reflection and reflection thinking.

Gauging from a mid-point score of 21, the students’ self-reported mean score of 24.5 in the main sample indicates a satisfactory level of reflective thinking. Similarly, there was also satisfactory level of understanding – a non-reflective thoughtful action (obtained score of 19.5 cf a mid-point score of 15). The obtained HA score of 11.1 (cf mid-point score of 12) reflected the status of the uPWP as being a new experience rather than a habitual action of the students. The two mean DA and SA self-assessment scores were found near the mid-point scores of 33. This would indicate that students are using both approaches in the rPWP.

Table 4. Reliability coefficients (Cronbach α), means and standard deviations (SD)

RQ scales	No. of items	Kember's (2000) study α	Possible score range	Pilot study		Main study	
				α	Mean (SD)	α	Mean (SD)
Critical Reflection & Reflection (CRnR)	7	CR: 0.68 R: 0.63	7 – 35	0.85	24.3 (5.4)	0.80	24.5 (4.7)
Understanding (U)	5	0.76	5 – 25	0.77	19.1 (3.6)	0.67	19.5 (2.9)
Habitual Action (HA)	4	0.62	4 – 20	0.57	11.2 (2.8)	0.49	11.1 (2.6)
LPQ scales		Kember's (2004) study					
Deep Approach (DA)	11	0.82	11 – 55	0.86	32.9 (7.7)	0.84	32.3 (7.2)
Surface Approach (SA)	11	0.71	11 – 55	0.66	33.4 (6.1)	0.60	33.4 (5.8)

Scores on the two instruments were also examined for possible associations. From the results, significant correlations between the factor scores of CRnR and DA ($r = 0.44$, $p < 0.01$) and between HA and SA ($r = 0.33$, $p < 0.01$) are present. TAS also showed low significant correlation with the scores from the Understanding scale ($r = 0.15$, $p < 0.05$). See Table 5. As expected, students who reported that they were critically reflecting or reflecting on tasks would be expected to report that they had adopted deep approaches. Similarly, students who reported that they were performing tasks without much thought would also be expected to perceive themselves as surface approach adopters.

Table 5. Bivariate correlations between scales of modified RQ, LPQ and TAS

	CRnR	U	HA	DA	SA	TAS
CRnR	-					
U	-0.06	-				
HA	0.09	0.11	-			
DA	0.44**	0.16*	0.07	-		
SA	-0.11	-0.02	0.33**	0.04	-	
TAS	0.00	0.15*	-0.05	0.03	-0.07	-

* $p < 0.05$. ** $p < 0.01$.

Factor analysis using the five RQ and LPQ factor scores along with the corresponding TAS revealed a three-factor structure, accounting for 66.77% of the total variance. Items that contributed to the understanding (U) scale and TAS results loaded together into one of these three factors. This factor explains 30% of the common variance. Regression analysis of this three-factor structure with TAS as a dependent variable shows that only understanding (U) is a significant predictor of TAS. The regression equation is $TAS = 29.86 + 4.51 (U)$. The beta-coefficient shows that 50% of the TAS is predicted by the regression score from the Understanding scale (Beta = 0.709). Though the factor and regression analyses suggest that teachers' assessment of

their students (TAS) could be predicted from one of the RQ scales, there is no evidence to demonstrate a relationship between TAS and desired scales such as CRnR and DA.

Ancillary Study – The reliability coefficients of the RQ and LPQ scales for this larger sample of three schools mirrored the trend shown in the main study (see Table 6). In terms of mean scores for the CRnR and U scales, students in the main study school reported higher values than the other schools. These findings suggest that promising insights about the effects of programme variability on reflective thinking development and learning approaches could be gleaned should there be further investigation.

Table 6. Reliability Coefficients (Cronbach α), means and standard deviations (SD)

	Cronbach α N = 561	Main study rPWP Mean (SD) n = 196	School A PBL and PWP Mean (SD) n = 181	School B PWP Mean (SD) n = 184
RQ scales				
Critical Reflection & Reflection (CRnR)	0.78	24.5 (4.7)	23.5 (4.6)	22.5 (5.0)
Understanding (U)	0.70	19.5 (2.9)	19.0 (3.0)	17.8 (3.9)
Habitual Action (HA)	0.49	11.1 (2.6)	10.7 (2.7)	11.1 (2.9)
LPQ scales				
Deep Approach (DA)	0.82	32.3 (7.2)	32.7 (7.2)	31.6 (7.4)
Surface Approach (SA)	0.53	33.4 (5.8)	34.7 (6.6)	33.6 (5.5)

Discussion and Conclusion

This exploratory study adopted a quantitative approach towards evaluating the assessment and grading procedures of a desired student outcome in a revised project work programme. It tested a basic assumption that there would be a positive relationship between teacher-awarded marks and students' self-assessment of their reflective abilities and learning approaches. This assumption rested on the premise that the development of reflective thinking can be measured both in terms of the task outcomes as well as in signposts observed during the journey to achieve these outcomes.

The findings suggest that more could be done to refine the methods used for assessing the development of reflective thinking in the programme. The lack of relational evidence between TAS and the higher levels of reflection might indicate that the measurement tools are either not 'sensitive' enough or not designed to measure the right indicators. It is also possible that the assessment and grading indicators are not used or interpreted appropriately as these are linked to visible evidence of performance and hence subjected to differing views. Another probable reason could be that the programme is promoting low level reflective skills. Qualitative evidence from teachers and students, together with a detailed examination of the methods and band descriptors used would be needed. There could be implications for pedagogy and curriculum arising from this re-examination.

This study also surfaced some challenges involved in assessing attitudinal or trait outcomes in school-based curriculum initiatives for formative assessment purposes.

Concerns about validity and reliability, both in terms of the construct (of the outcomes) to be measured and the tools designed to measure this construct, must be addressed. For learning to take place, interpretations of teachers' assessments must be accurate, useful and timely. These requirements will impose difficulties and schools must commit substantial resources to resolve them. One important commitment would be the professional growth of their teachers. As vital participants of the curriculum development, they will need to learn and demonstrate a better understanding of assessment and its uses, especially in the relevant non-cognitive attributes. This would help teachers prepare for school-based assessment which is likely to be an integral part of teaching in the future.

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Appendix 1 Common components in the Transformative Learning Theory (Mezirow, 1991, 2000) and the rPWP (adapted from Rogers 2001)

Component	
Antecedents	Triggered by unusual or perplexing event Requires readiness, willingness and conscious choice on part of learner
Definitional components	Cognitive and affective process or activity Requires active engagement on part of individual Triggered by an unusual or perplexing situation or experience Involves examining one's responses, beliefs, & premises Results in integrating new understanding gained into one's experience
Process	(1) Identify a problem and make a deliberate decision to seek a solution (2) Collect additional information regarding the problem (3) Plan a solution and make a decision to act (4) Take action based on the plan