Approaches to Learning and Learning Environments in Problem-based versus lecture-based learning

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Abstract

One desired outcome of our educational goals is that our student's approach to studying by searching for meaning rather than superficially memorizing and regurgitating knowledge. To some extent, students have their own preferred approaches to studying. However, research by Ramsden and Entwistle suggests that the learning environment we use in our classrooms also affects the student's approaches to studying. Two published inventories to measure these effects are the Lancaster Approaches to Studying Questionnaire, LASQ, and the Course Perceptions questionnaire, CPQ. Data from the short version of these questionnaires were analyzed for a group of students concurrently registered in two programs. Students were registered in a cross-section of disciplines in humanities, social science, science and engineering where the method of instruction was primarily the conventional lecture. Those same students were concurrently registered in the "Theme School" program, an interdisciplinary program of 33 credits where the method of instruction was small group, self-directed problem-based learning. These sophomore students who selected the Theme School program scored high on the LASQ on both the strategic and "deep" learning scales and relatively low on the "surface" learning orientation. They scored high on the Perry inventory.

On the CPQ they rated their home departments as 21.6 with a standard deviation of 10.32. They rated the theme school as 40.09 with a standard deviation of 7.57.

I. Introduction

Effective learning is a unique combination of the learning environment and the student's preferred orientation toward learning. Chickering and Gamson[1] and Ramsden[2] suggest key principles to follow to create an effective learning environment are:

> 1. Stimulate interest and provide quality explanations.

> 2. Show concern and respect for students and students learning.

> 3. Use appropriate assessment with genuinely helpful feedback.

> 4. Have clearly stated goals that are intellectually challenging and expect students to succeed.

5. Provide students with a choice over how to learn the subject matter in active and cooperative learning environments.

6. Focus on "student learning" rather than on "teacher teaching" by diagnosing how well the learning is progressing and modifying things accordingly.

One measure of learning, especially the higher order thinking and critical appraisal skills, might be the student's approaches to studying. [3-6] In general, approaches to study includes three orientations toward learning: strategic orientation, reproducing orientation and meaning orientation. These are described as follows.

In *strategic* orientation, the students are well organized, determined, confident and skilled at sensing what is going to be on the exam and studying for that. They tend to be competitive. They work hard and will do whatever is needed to succeed. If the teacher wants memorization, then I'll memorize and regurgitate. If the teacher expects comprehension and understanding, then I'll use a deep orientation. Students are mainly motivated by a need to achieve. Some refer to such orientation as "versatile" or "flexible."

In *reproducing* orientation, students are preoccupied with rote learning. They anxiously are concerned with details and tend to learn what they are told to learn. They restrict their learning resources to the classroom and the required textbooks. Accept ideas and information passively without the necessary critical thinking. Fail to search for guiding principles and patterns. They are extrinsically motivated with an over riding concern for qualifications. Some use these terms to describe "**surface**" learning.

In "*meaning*" orientation students intent to understand what is being studied. They look for meaning in what they are studying, interact actively with what they are learning and search for links between what they are studying and real life. They examine evidence critically and use it cautiously. They try to relate the new knowledge to previous knowledge. They want to learn for its own sake. They relate different ideas together and thoroughly use available information in drawing conclusions. Use critical thinking. They are intrinsically motivated. Some use these terms to describe "**deep**" learning.

Sometimes it is useful to define a "net orientation" that is the sum of the deep and strategic orientation less the surface orientation.

Ramsden and Entwistle[7] found that student's preferred orientation to learning was influenced by eight elements in the learning environment. The six elements that positively promote learning are:

1.   - **good teaching**: the perception of the preparation, confidence and skill of the faculty in facilitating learning;

2.   - **openness to students**: willingness of faculty to help, friendliness and flexibility of faculty.

3.   - **freedom in learning**: the degree to which the students feel they have a choice in what they learn and how they learn it;

4.   - **clarity in goals and standards:** a degree to which the students feel that the assessment is clearly defined and appropriate; for example, a low rating would be given if the students feel that "professors are more interested in testing what we have memorized than what we have learned."

5.   - **vocational relevance:** how pertinent the students perceive the course content to be for their future careers;

6.   - **social climate:** students report good academic and social relationships with each other.

The two elements that tend to negatively promote learning are:

7.   - **workload:** excessive demands from the curriculum and the assessment procedures. "The shear volume of work to get through in this course means that you can't comprehend it all thoroughly."

8.   - **formal teaching methods:** the student's perception that timetabled lectures (versus self-directed, group or individual study) are the main source of learning.

For example, the elements that tend to promote **surface** learning include inappropriate assessment methods (especially the use of short answer and multiple choice questions for factual recall), heavy workload [#7 above], perceived inadequacies in teaching [#1 above], inadequate feedback on assignments, long delay before feedback, spoon-feeding through handouts and lack of relevance or choice [#3 & # 5 above].[8-10] In particular, heavy workload and lack of freedom in learning [defined by Ramsden[11] as control-centeredness] correlated with **surface** orientation ($p < 0.001$).

The elements that promote **deep** learning orientation include matching the content to previous knowledge, the perceived relevance of subject matter [#5 above], good teaching (with appropriate level, pace, structure, explanation, enthusiasm and empathy) [#1 above], opportunities for individual choice [#3 above] and study skills training and support.[8, 12] In particular, good teaching plus freedom in learning [defined by Ramsden[11] as student-centeredness] correlated with **deep** learning orientation ($p < 0.01$).

Questionnaires have been developed to measure both the students' approaches to studying and to the students' perceptions of the learning environment.

II. Questionnaires to measure study orientation and the learning environment

Questionnaires to help students identify their approaches to studying have been developed as follows

- Lancaster Approaches to Studying,[6] LASQ, uses 64, 5-point Likert scale questions to identify 16 subscales of which 12 are pertinent to the three subscales of strategic, surface and deep orientation.

- modified LASQ[13] (ASI) uses 49 questions to identify deep, strategic, surface learning plus non-academic orientation, study habits and methods and basic academic skills.

- short version LASQ[14,15] uses 18, 5-point Likert scale questions to identify three subscales: strategic, surface and deep.

- very short LASQ[16] uses 12, 5-point Likert scales questions to identify three subscales.

- Biggs' Study Process Questionnaire,[17] SPQ (1979), uses 42, 5-point Likert scale questions to identify six subscales: strategic (strategies and motivation), surface (strategies and motivation) and deep (strategies and motivation).

- Bigg's Study Behaviour Questionnaire,[18] SBQ (1976), uses 80 questions to identify ten subscales: deep learning, surface learning, pragmatism, academic motivation, academic neuroticism, internality, study skill, test anxiety, openness, and class dependence.
- Schmeck et al. [19] (1977) Inventory of Learning Processes, ILP, (used by Watkins and Hattie[20])

Questionnaires have been developed to measure the students' impressions of the learning environment.

- Course Perceptions Questionnaire,[6] CPQ, uses 40, 5-point Likert scale questions to score the eight elements of the environment listed above.

- mid 'CPQ'[21] uses 34 items for quality of "lecturing," clear standards, methods of assessment,. relevance and workload.

- short CPQ[15,16] uses 24 questions for the eight elements.

- Course Environment Questionnaire,[2] CEQ, uses 40, 5-point Likert scale questions to rate six elements: teaching, freedom and independence, clarity of goals, assessment and workload.

- Survey of the Learning Environment,[22] SLE, (Marshall) uses 54, 5-point Likert questions to rate seven elements: emotional climate toward the affective domain, supportiveness of staff for the students, flexibility in learning for the students, organization and coherence of the educational experience, vocational relevance,

student-students interaction, extent to which students are encouraged to sustain outside and non-academic activities.

Related to approaches to study, and to the issues addressed in this work, is student expectations of the learning environment. Perry[23] analyzed student's attitude about their role and created a model that includes four pertinent "levels" starting with Level 2. The Perry levels[23,24] are:

> Level 2. Every point of view is either right or wrong, all knowledge is known and obtainable from teachers and texts, and the students' role is to absorb what they are told and demonstrate having done so by repeating it back, confusion occurs if the text and the teacher do not agree, if a student does poorly on an exam that's because the student is a bad student.

> Level 3: Most information is known but there are some fuzzy areas, the teacher's role is to tell students how to learn, the student's role is to work hard, if students work hard they should get good marks. The student's preferred task is to compare and contrast.

> Level 4: Some knowledge is known, there is no certainty and any idea is OK. Students feel that their answers are as good as the teachers, the teacher serves as a role model which can be discounted, the students are to think for themselves and independent thought is valued (even if it is not substantiated by evidence), good marks should be given to students who show independence. Students can separate assessment of performance from a sense of self worth. The student's preferred task is analysis.

> Level 5: Different knowledge is needed in different contexts, there is no absolute truth with good answers existing once the conditions are known, the teacher is a resource, students are to identify the conditions and to choose the best ideas. For assessment, students seek both positive and negative feedback with their preferred assessment task being synthesis and relating ideas between contexts.

A variety of questionnaires and scoring schemes have been developed to estimate the student's Perry "level." The inventories of Moore-Fitch (1988) and Gainen (1987) are published[24] and were used in this current study.

III Published Data

Ramsden reported the results of 4500 student responses to the CEQ in 50 different Australian institutions in nine subject disciplines. Departments ranked from highest to lowest were visual and performing arts, humanities, education, social science, natural science, mathematics and computing, business and law, engineering with health science receiving the lowest rating on the CEQ. Ramsden and Emtwistle[7] report the results of the LASQ and the CPQ for nine subject disciplines, 66 Departments in the UK and 2208 students. Departments ranked

from highest to lowest on the CPQ were economics, psychology, engineering, physics, history and english.   Feletti et al.[22] provide data for the SPQ and SLE for 213 students in four institutions for four subject disciplines taught via problem-based learning. Coles[25]   reports on the short LASQ for medical students in conventional and in problem-based programs. Trigwell and Prosser[16] used the very short LASQ with 122 year I nursing students. Newble and Clarke[26] used the LASQ for Australian conventional and PBL medical students; Newble and Gordon[27] used LASQ with three groups of medical students: 1st year, 3rd year and 6th year. Clarke[28] used the LASQ with 1st, 3rd and 5th year medical students at the University of Newcastle, a PBL program. The absolute values of these are difficult to compare because different questionnaires were used.

In this current research, the short versions of both the LASQ and the CPQ are used. The following studies have used these inventories. Bertrand and Knapper[16] studied 184 students in one institution and three subject disciplines. The results for a snapshot (as opposed to longitudinal data) results for years two and four are given in Table 1. The Chemistry students tended to be "surface processors;" the Environmental Resource Studies students tended to prefer "deep processing". The Psychology students tended to prefer a "strategic approach" toward "high marks."

Engineering colleagues from eight institutions in Canada and the United States have used the short LASQ and CPQ with 1387 engineering students in years 1 to 4. The results are given in the penultimate column of Table 1. Data for sophomore chemical engineering students at McMaster University are given in the last column.

For the attitude toward learning as measured by the Perry inventory, Allen[29] reported that college freshman have mean scores of 2.3 to 3.1. Fitch and Culver[30] give data for seniors in the range 2.8 to 3.1. Woods at al.[31] reported values for juniors at 3.5 with values for seniors graduating from a partial PBL program to be 4.6. The Perry level for the sophomore cohort given in Table 1 was 3.26 with a standard deviation of 0.66. There was no statistically significant difference between the data from the Gainen and Moore-Fitch questionnaires.

Table 1. North American institutions using short forms for both LASQ and CPQ The standard deviation is shown in square brackets [ ]

	Science, Chemistry		Psychology		Environmental resource		Engineering N = 1387	Chemical Engineering, N = 84
	2nd	4th	2nd	4th	2nd	4th	all years	2nd
Strategic	15.29	13.87	16.54	15.33	13.39	13.57	16.17 [3.1]	15.15 [2.8]
Surface	14.63	13.9	14.89	12.47	10.87	10.33	15.15 [3.15]	15.33 [3..3]
Deep	14.09	15.65	14.70	15.81	17.39	16.48	14.86 [3.7]	14.01 [3.6]
Total	14.75	15.62	16.35	18.67	19.91	19.72	15.85 [6.7]	13.92 [5.43]
good teach	5.77	6.23	8.14	6.81	7.13	8.81	7.07 [2.38]	8.77 [1.8]
openness	4.74	5.03	7.43	6.03	8.52	9.48	6.64 [2.65]	8.37 [2.0]
freedom	3.66	3.48	5.73	6.36	10.17	10.43	5.33 [2.41]	5.44 [2.3]
clear goals /standards	6.09	6.55	8.46	8.03	3.87	6.29	7.59 [2.21]	7.64 [2.0]
vocational relevance	5.63	5.35	5.03	3.19	4.96	4.33	7.76 [2.35]	8.44 [1.75]
social	7.26	7.42	5.97	5.25	7.96	8.38	7.71 [2.15]	7.98 [1.88]
workload	8.43	8.42	4.92	4.86	7.17	4.14	8.27 [2.66]	8.29 [2.4]
formal methods	7.11	7.26	6.11	5.11	3.00	2.86	7.02 [2.19]	6.83 [1.97]
Total	17.61	18.38	29.73	25.7	32.44	40.72	26.8 [12.33]	31.46 [8.4]
Control	14.77	14.94	9.19	8.5	7	3.71	12.9 [3.77]	12.8 [3.35]
Student	9.43	9.71	13.87	13.17	17.3	19.24	11.55 [4.15]	14.2 [3.31]
student/ control	0.63	0.65	1.51	1.55	2.47	5.19	0.89	1.11

IV. The Context of this study

At McMaster University, the Theme School program was created. This is a program for interdisciplinary learning that students from all disciplines may elect to take on overload. Based on the research expertise at McMaster, one of the Theme Schools is on **new materials and their impact on society**. This School has five 3-credit courses, three 2-credit seminar courses and two 6-credit research internships. Enrolment is limited and by application. About 35 students were admitted in both the first and second year since it was started. Students are from English, biology, physical education, nursing, chemistry, mathematics and engineering. The 3-credit courses use the small group self-directed problem-based format, PBL. For each course has two instructors and one teaching assistant. The first course is sophomore level. In each 13-week course the tutorless student groups handle two to three cases or problems. Concurrently they are taking five to seven required courses in their major area that are presented in the conventional

lecture style (except for the nursing program that is uses PBL). Before entering the Theme School program, the students have received no formal training in the processing skills (change management, problem solving, team work, self assessment and self-directed learning). In the Theme School we provided five explicit, 1½ h workshops on a) understanding PBL and its expectations, b) managing change, c) problem solving, d) group skills and e) self-directed-interdependent small group learning following the text by Woods (1994).

V. Methods

Within the first week, we administered the short LASQ questionnaire and the Gainen and Moore-Fitch instruments to measure the Perry level.

For PBL to be most effective, the students should have an attitude that their role is to manage their learning, the teacher is a resource and their role is to identify the pertinent issues in a situation. This is consistent with Perry level 5.

The students completed the Course Perceptions Questionnaire about week 10. They were asked to complete it twice: once in the context of the learning environment provided in their discipline-specific, home department and once in the context of the Theme School.

VI. Results and discussion

Characteristics of the cohort of students selecting the Theme School. The results are given in Table 2. Those students electing to go into a program (that is advertised as being PBL) entered with the desired attitudes and desired approaches to studying.

Based on the Perry level (target for PBL) is level 5. The sophomore students electing the Theme School all had values greater than 4.5. This a select group of sophomores because, as noted in Part III, typically sophomore students have values less than 4.

Concerning the approaches to studying, ideally for PBL the students will have a low preference for surface learning and a high preference for deep learning. The students entering the Theme School have that preference compared with the sophomore students entering Chemistry, Psychology and Chemical Engineering, as shown in Table 1. Students entering the Theme School had a ratio of deep to surface preference of 1.17 whereas published data for sophomore students in Chemistry, Psychology and Chemical Engineering programs have ratios of 0.96, 0.99, and 0.91 respectively. The students entering the Theme School have high values of the Total learning approaches of 18.5 compared with 14.75, 16.35 and 13.92 for Chemistry, Psychology and Chemical Engineering disciplines, respectively. The exception is those students entering Environmental Resource Studies, a program selected by Bernard and Knapper [15] because it stresses student project work, freedom in learning, informal instruction methods that create close teacher-student relationships. These perceptions, according to Ramsden and Entwistle,[7] are associated with meaning orientation which leads to an expectation

that the ERS students will score highest on deep learning. These data show the similarity in ratings between the ERS program and the Theme School program.

Student's perceptions of the two learning environments. The results of the short CPQ are given in Table 2. Students rated the PBL environment in the Theme School statistically significantly higher than the learning environment in their major department. The Total CPQ score for the Theme School is 40.01. Based on Ramsden's research[11] the most significant measure of environments that promote deep learning is the students-centeredness; the control-centeredness is related to the promotion of surface learning. The ratio of student to control centeredness for the Theme School is 3.94. For the home Department it is 0.66. Both the values of the Total CPQ scores and of the ratio for their home department, and for science, psychology and chemical engineering are 21.6 and 0.66, 29.7 and 1.51 and 16.6 and 0.63, 21.6 and 0.66, respectively.

The Theme School seems to be even more advantageous to the promotion of deep learning that the Environmental Resource Studies program with a Total CPQ of 32 and a ratio of 2.47.

VII. Conclusions

1. The short LASQ and short CPQ inventories supply data that are useful in describing the learning environment.

2. Benchmark data are given for the results of the short LASQ and short CPQ inventories for students in engineering programs.

3. Students who elect to enter a problem-based learning environment scored high on deep learning, on total learning orientation and on Perry level. These are consistent with the expectations promoted in PBL environments. These scores are much higher than those entering courses taught by conventional methods.

4. Students registered in conventional or traditional programs tend to perceive their learning environment as being that promotes surface learning.

5. Students concurrently registered in PBL and "conventional" programs rate the learning environment in PBL significantly more conducive to depth learning.

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Table 2 Data for a North American University program where the same cohort of students concurrently are enrolled in courses delivered in PBL and traditional modes.

	Theme School 2, N=32	
A. Strategic	16.22 [2.9]	
B. Surface	13.25 [4.37]	
C. Deep	15.53 [3.26]	
Total	18.5 [7.33]	
	Theme Dept. PBL mode	Home Dept. conventional mode of instruction
Good teaching	9.3 [1.5]	6.0 [2.2]
Openness to students	9.8 [1.3]	5.9 [2.5]
Freedom in learning	10.75 [1.27]	3.78 [3.0]
Clear goals, standards and assessment	4.75 [2.3]	8.69 [1.9]
Vocational relevance	6.78 [2.2]	6.75 [2.6]
Social climate	7.63 [1.66]	7.3 [2.6]
- Workload	5.84 [2.77]	8.5 [2.5]
- Use of formal teaching methods	2.66 [1.77]	8.3 [2.3]
Total	40.09 [7.57]	21.6 [10.32]
Control-centered	5.09 [2.67]	14.72 [3.99]
Student-centered	20.06 [2.19]	9.78 [4.66]
Student/control	3.94	0.66

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