Involvement, Engagement and Implications
- indicators of teaching development potential
in a large Stage 1 Physics course

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November 2011

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Purpose

In Physics 120FC, 'The Physics of Energy', there has been a shift from content-centred teaching to student-centred teaching and learning through the introduction of several new teaching and learning strategies to increase involvement and achievement. This shift has employed the application of Vygotsky's socio-cultural perspective, the use of strategies such as Team Based Learning and 'clickers' and a greater emphasis on shared achievement. These strategies seem to collectively contribute to a significant improvement in student achievement:
2009: 62.3% gained C- or better with cut off at 45.3% and 46.8 average.
2011: 75.3% gained C- or better with cut off 49.8% and 55.1% average.
While 'involvement' of students has increased and achievement has improved it is still necessary to determine potential for improving teaching, learning and achievement. To do this the perspective of 'cognitive engagement' was investigated.

Background

While it is common practice for educators to interchange the words 'involvement' and 'engagement', the use of 'engaged' must be used with caution as there is a developing background of theory that distinguishes 'active learning' from 'engagement' which has specific implications.

During the early months of 2011 the Derek Bok Centre for Teaching and Learning (Harvard University) indicated :
• **active learning** includes in-classroom methods that involve students in the learning process requiring meaningful learning activities that cause them to think about what they are doing.
• **co-operative learning** is a structured form of group work when students pursue common goals while being assessed individually.

The definition of **engagement** is developing more specific definition with time. In Finn's (1989) model, engagement is comprised of behavioural (participation in class and school) and affective components (identification, belonging, valuing learning). Similar definitions have been offered by Newmann, Wehlage, and Lamborn (1992) and Marks (2000). More recently, engagement has been defined as having three subtypes: *behavioural* (positive conduct, effort, participation), *cognitive* (e.g. self-regulation, learning goals, investment in learning) and *emotional or affective* (e.g. interest, belonging, and positive attitude about learning (Fredericks et al, 2004; Jimerson, Campos, & Greif, 2003). While **engagement** was viewed as reflecting a person's active involvement in a task or activity (Reeve, Jang, Carrel, Jeon & Barch, 2004), 'engagement' has now developed to include specific sub-divisions of *cognitive engagement, emotional engagement*, and *psychological engagement.*

Russell, Ainley and Frydenberg, 2005, (P1) define engagement as "*energy in action*, the connection between person and activity". Ball and Perry (2010) define *engagemen*t as "students' involvement with activities and conditions likely to generate high quality learning"

Measuring student cognitive engagement

Bell and Perry (2010) identify the *Cognitive Processes* and attempt to *Explain the Dominant Cognitive Processes*. They use Felder and Brent's argument that "*students have different levels of motivation, different attitudes about teaching and learning, and different responses to specific classroom environments and instructional practices. The more thoroughly instructors understand the differences, the better the chance they have of meeting the diverse learning needs of all their students*."

Bell and Perry indicate that each cognitive type has a distinctive pattern of processes:

• for what energizes:
  - Interaction with others – Extraversion
  - More solitary activities – Introversion

• for what is accessed in information gathering
  - Tangible, experiential awareness - Sensing
  - Conceptual, symbolic awareness – Intuiting

• the process of organizing, evaluating and deciding on information
  - Based on criteria or principles – Thinking
  - Based on appropriateness of worth – Feeling

They indicate that each of the possible combinations of these dichotomies leads to differences in cognitive processes.

Sharan and Goek Chin Tan describe *cognitive engagement* as "understanding engagement through active or self-regulated involvement in learning". This provides an understanding of the cognitive processes involved in active learning through Jung's *Eight-Functions Model, which* defines the *Perception Processes*, recognizing the four types of perceived data (the way things are, the way they used to be, the way they could be now, and the way they will ultimately be) and the *Judgment Functions* as the ways we organize experiences and make decision about the data.

The Four Perception Processes *we use these to focus attention and gather information*
Extraverted Sensing (Se)
Introverted Sensing (Si)
Extraverted Intuiting (Ne)
Introverted Intuiting (Ni)

The Four Judgment Processes *We use these to organize experiences and make decisions*
Extraverted Thinking (Te)
Introverted Thinking (Ti)
Extraverted Feeling (Fe)
Introverted Feeling (Fi)

While all eight of these processes are available, we develop some more than others and the dominant process is the one we most commonly use and trust. The relationship between the dominant and auxiliary is the combination of how we prefer to take in information and our preferred processing and decision making.

Ball and Perry outline the possible linkages between the Eight Cognitive Processes and Measures of Active Learning. They needed to determine if some processes were more aligned to engagement than others. They first established if the eight cognitive processes could be linked to the seven areas of active learning investigated by the Australian Survey of Student Engagement (AUSSE) instrument.

Ball and Perry used a panel of three educators to determine what linkages exist between Jung's Eight Functions Model and the AUSSE instrument. They determined that:

- The Introverted Intuiting (Ni) process is only highly cognitively engaged if there is the opportunity to ask questions in-class or on-line. They have medium cognitive engagement if they are involved in discussions and community-based projects.
- The Extroverted Intuiting (Ne) is highly cognitively engaged in many more types of activities including working with other students both inside and outside class, making presentations, and during in-class discussions.

Ball and Perry conclude that students with a preference for a cognitive process that is Ni would have some difficulty in achieving well in most of the active learning occasions and determined that those students whose cognitive processes indicate a preference for Extraverted Feeling (Fe) would be more actively involved than students with a preference for the Introverted Feeling (Fi) processes. They tentatively concluded that it seems likely that students preferring different dominant cognitive processes will differ in their approach to a number of the active learning activities.

While Ball and Perry were trying to determine if students in different disciplines displayed differences in their use of dominant cognitive processes and hence differ in their levels of engagement*, in this study for Physics 120FC at the University of Auckland, the focus was " to what extent is the choice of dominant processes common to all students? What implications do these distributions have for future teaching and learning?*

Procedure methodology

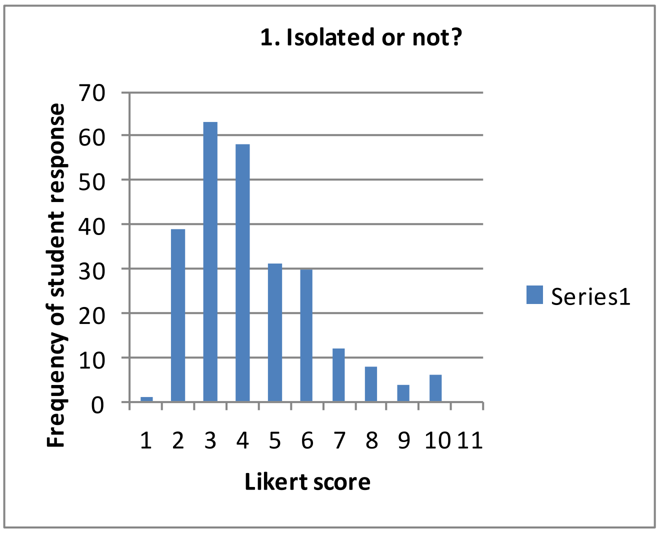
Students were asked to respond to same survey used in 2010 with approval from the University of Auckland Human Participants Ethics Committee Ref 2010/228. The questions were intended to help lecturers determine if the balance of support strategies and activities helped students to achieve better learning and assessment scores.

Students scored their responses on a Likert scale with 1 being low and 10 being high. There were 308 students enrolled and 252 responses were received from students. This gave a Confidence Level of 99% with a confidence interval of 2.03.

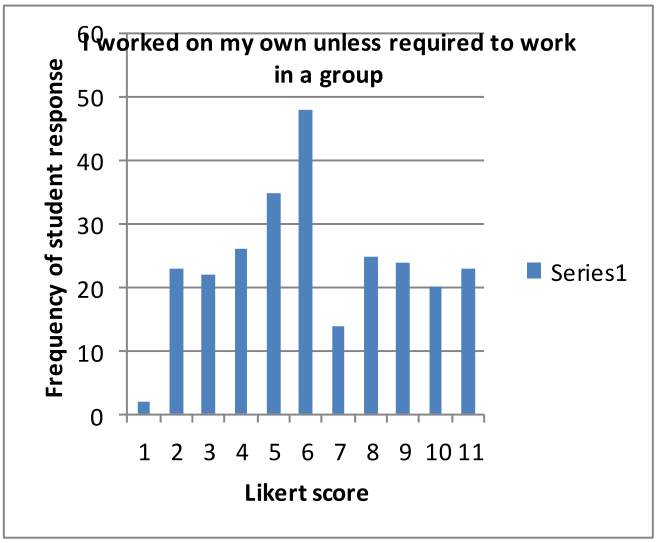
The questions, survey data and comments are provided sequentially below:

Question 1:
I felt quite isolated as a student with little support available as I studied Physics 120
Data:
Mean = 3.31
Standard Deviation-A (σ_{n-1}) = 1.90

Question 2:
I worked most often on my own and not with other Physics 120 students except when I needed to in Laboratory Tutorials
Data:
Mean = 5.25
Standard Deviation-A $((\sigma_{n-1}) = 2.61$



Responses to Question 1



Responses to Question 2

The next several questions sought to distinguish between 'active involvement' and 'engagement' by asking questions that relate the person to activity, as indicated by Russell, Ainley and Frydenberg, 2005, (P1). These questions may not provide the ability to discern if the named activity type provided "the conditions to generate high quality learning" as in the definition by Ball and Perry (2010). However in this report the intended focus is on ***cognitive engagement***.

The questions were developed to utilize Jung's *Eight-Functions Model* in which he defines the *Perception Processes* and the *Judgment Functions* and then indicates that the dominant process is the one we most commonly use and trust. In Jung's theory, the relationship between the dominant and auxiliary is the combination of how we prefer to take in information and our preferred processing and decision making.

The Four Perception Processes *we use these to focus attention and gather information*
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Introverted Intuiting (Ni)

The Four Judgment Processes *We use these to organize experiences and make decisions*
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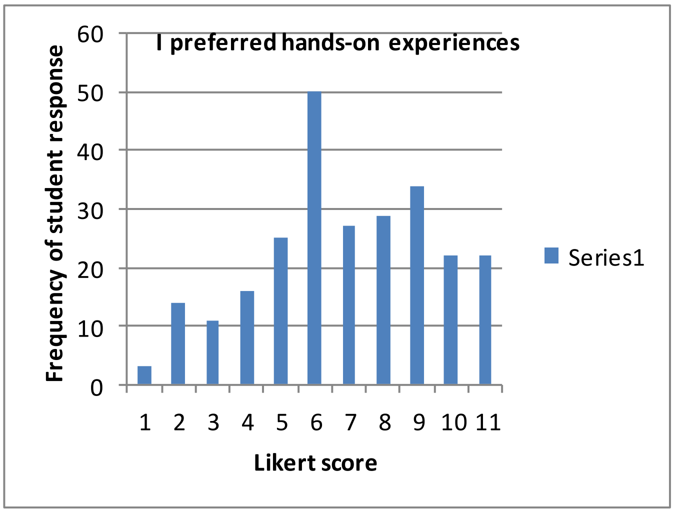
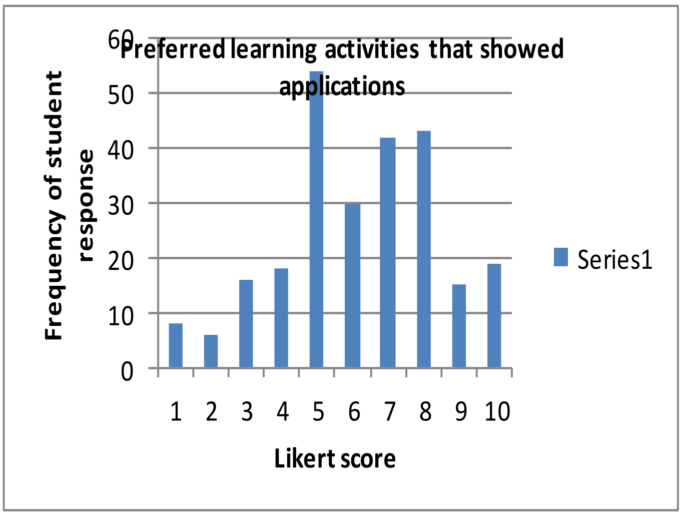
Introverted Thinking (Ti)
Extraverted Feeling (Fe)
Introverted Feeling (Fi)

Question 3:
I preferred learning activities that provided hand-on experiences (interactive & experiments) and did not prefer the conceptual & symbolic (book-type) learning.
Data:
Mean = 5.96
Standard Deviation-A (σ_{n-1}) = 2.49

Question 4:
I preferred learning activities in Physics 120 that provided learning about ideas in Physics that had applications and worth and did not prefer learning through thinking and deciding type activities.
Data:
Mean = 6.19
Standard Deviation-A (σ_{n-1}) = 2.18



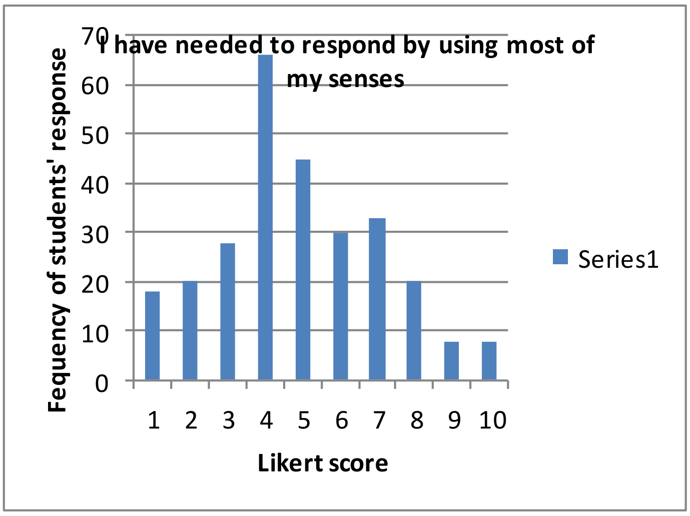
Responses to Question 3



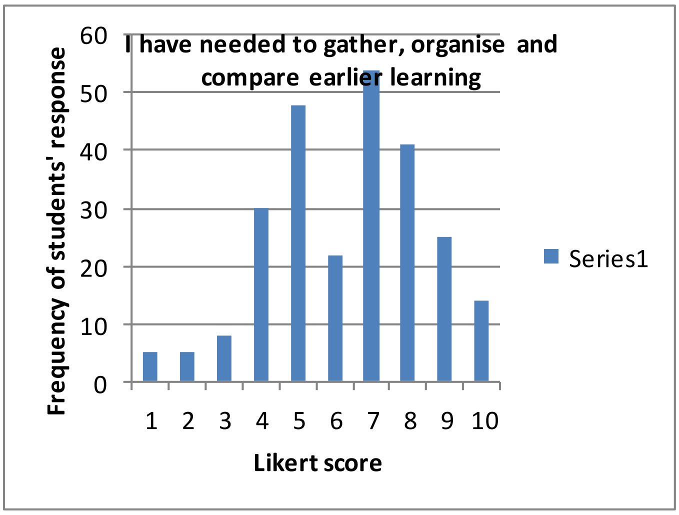
Responses to Question 4

Question 5:
Physics 120 has provided experiences that have required me to respond by using most of my senses including touch, sight, hearing etc.
Data:
Mean = 4.93
Standard Deviation-A (σ_{n-1}) = 2.26

Question 6:
Physics 120 has required me to gather and organize a large amount of information and I have been able to compare ideas to earlier learning about Physics. This has allowed me to develop a more accurate understanding about Physics.
Data:
Mean = 6.35
Standard Deviation-A (σ_{n-1}) = 2.07



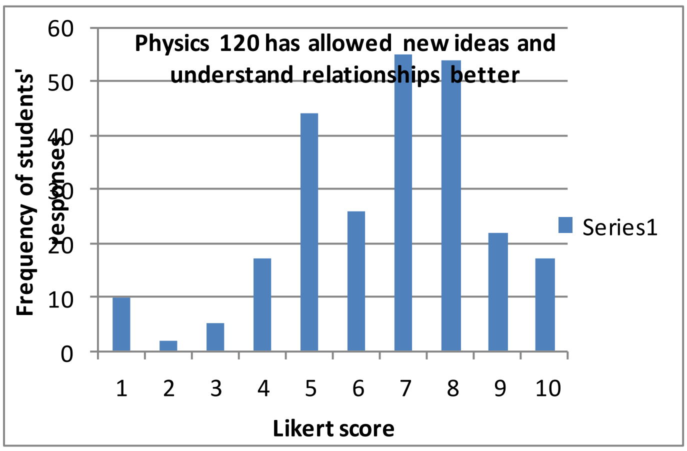
Responses to Question 5



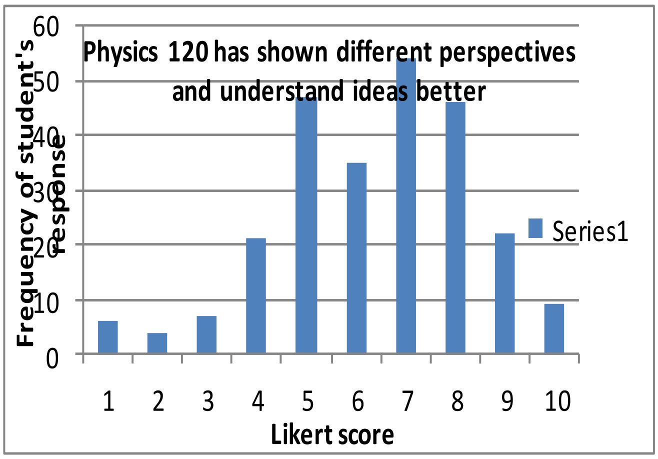
Responses to Question 6

Question 7:
Physics 120 has enabled me to see some new and different possibilities in Physics ideas and to better understand relationships between ideas and applications.
Data:
Mean = 6.56
Standard Deviation-A (σ_{n-1}) = 2.11

Question 8:
Physics 120 has allowed me to see ideas from several perspectives and allowed me to better understand ideas by correcting ideas I did not understand correctly. It has required different ways of thinking about ideas.
Data:
Mean = 6.37
Standard Deviation-A (σ_{n-1}) = 1.95



Responses to Question 7



Responses to Question 8

Findings

1) More than 68 % of students (± 1 σ) indicated they were not isolated, rather they felt supported in the study of Physics 120FC.

2) That the average score is not higher is good. Students are working cooperatively, even in aspects of the course excluding Team Based Learning where cooperation was essential. Early in the semester students were encouraged to form work groups and share their learning. This response seems to indicate that students are benefiting from this encouragement.

3) The data seems to indicate we have a balance of students that have a slight bias toward *extraverted intuiting (Ne)*. Ball and Perry's theory, applied to the Physics 120 cohort, indicates that the students in Physics 120 are biased toward being highly cognitive and able to be engaged in many more types of activities including working with other students, both inside and outside class, making presentations, and in-class discussions.

4) The student cohort is strongly *Extroverted Feeling (Fe*) in Jung's Judgment Processes. Over 68% (± 0.5 Standard Deviation-A) do prefer to learn ideas that have application and worth.

5) The balance in the data relating to students use of the Perception process of *extroverted sensing* showed only about half of the students in the cohort utilized most of their senses.

6) This question was intended to determine the degree of *introverted sensing* used by students. There is a strong bias of students with over 70% expressing that they were able to gather and organize, compare earlier learning and to gain a more accurate idea about Physics through the teaching and learning strategies used.

7) This question was intended to determine the relative bias on the *Extroverted Intuiting (Ne)* Perception Process. Since over 78% of Physics 120 students indicated a score greater than 5.40, the cohort of students is highly engaged in cognitive activities. This reinforces Ball and Perry's indication that the Extroverted Intuiting (Ne) student is highly cognitively engaged in many types of activities.

8) The data shows that over 70% of students are biased toward the *Introverted Intuiting* Perception Process. They are strongly able to personally consider and perceive ideas from several perspectives and show divergent thinking processes, enabling them to correct misconceptions.

Key Outcomes

By applying Jung's 'Eight-Functions Model' it has been possible to show that, in terms of Cognitive Engagement, the 2011 cohort of Physics 120 FC students are strong in all of the Perception Processes, though there is a need for more strategies that will support the use of more student senses to develop their extroverted sensing Perception Processes. The following discussion identifies a potential areas for teaching strategy development.

It seems we should be reasonably confident that we can increase the range of activities including class discussions and other interactions and know that most students will be capable of good cognitive engagement in these. There are good indications to lecturers that learning may occur best if contextual learning is used, giving actual applications. We might need to use a greater variety of strategies to encourage students to perceive ideas fully. Students seem very capable of working with other students in several ways, including in-class discussions. Lecturers can confidently increase the use of strategies that include student responses.

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