Problem-Based Learning Using HARP Instruction

Academic High Altitude Conference

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Psychology Research

High Altitude Research Platform

Hypothesis

❑**Hypothesis 1 – Problem-Based Learning**

The event group (control group) who did not use a problem-based teaching approach in implementing the HARP program would do significantly worse than the novice group, experienced group, and the expert group who did use a problem-based teaching approach in implementing the HARP program on valuing of science, application, intrinsic motivation, cognitive skills, metacognitive skills, and content knowledge.

❑**Hypothesis 2 – Specific Feedback Improvements**

Professors that integrate a problem-based teaching approach in implementing the HARP program with guided improvement suggestions two or three times (experienced group) were able to achieve growth in their students that equals the expert group classrooms on valuing of science, application, intrinsic motivation, cognitive skills, metacognitive skills, and content knowledge.

❑**Hypothesis 3 – Continual Expert Improvements**

Expert groups that continue to be evaluated and receive constructive feedback on how to improve their problem-based teaching approach in implementing the HARP program into their curriculum will show significant improvement on valuing of science, application, intrinsic motivation, cognitive skills, metacognitive skills, and content knowledge.

Demographics

There were 39 participants in the Fall of 2007, 111 in the Fall of 2008, 198 in the Spring of 2009, 208 in the Fall of 2009, and 298 in the Spring of 2010. There were 446 males and 360 females with 43 students that did not indicate their gender of the 849 participants. The students had various degrees of academic science focus with 191 students coming from a hard science background, 79 students coming from a soft science background, 281 students coming from a non-science background and the rest of the students did not provide the necessary information. There were 201 students who were freshman, 189 sophomores, 97 juniors, 97 seniors and 265 students did not provide this information.

There were 682 students that who were taking the class as a general education class where the HARP program was implemented and 167 students were planning to take upper division classes in the sciences and 74 students who were currently involved in upper division science classes.

Reliability & Validity

Reliability: The degree to which an instrument will produce the same results each time it is administered to the same person in the same setting.

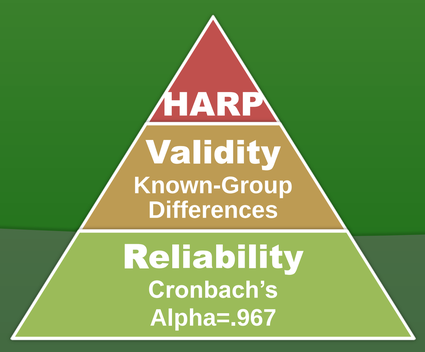
❑ Results: The overall pre-test Cronbach's alpha (α = .976) and the post-test Cronbach's alpha (α = .965) are both excellent. These results indicate that the HARP assessment instrument is reliable.

❑ Deduction: The assessment tool is a reliable instrument.

Validity: the extent to which a test measures what it claims to measure.

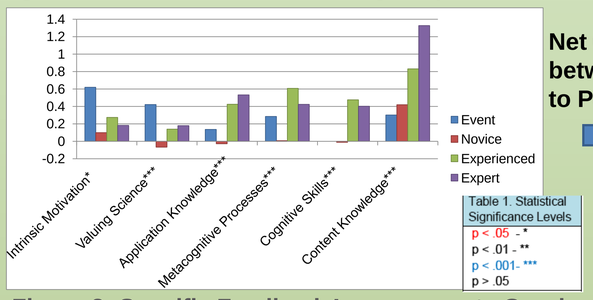
❑ Content Validity: A content evaluation was performed by experts knowledgeable of the New Heights Program. The creators of the New Heights Program and professors experienced in testing methods developed questions that would measure growth (in the areas of intrinsic motivation, valuing science, application knowledge, metacognitive processes, cognitive skills, and content knowledge) due to participation in the program.

❑ Construct Validity: The Known-Group Difference method was used to assess the construct validity of the High Altitude Research Platform (HARP) Assessment tool. Results of this method indicated that the dependent variables changed in a manner that one would predict them to change based on previous knowledge or speculation.



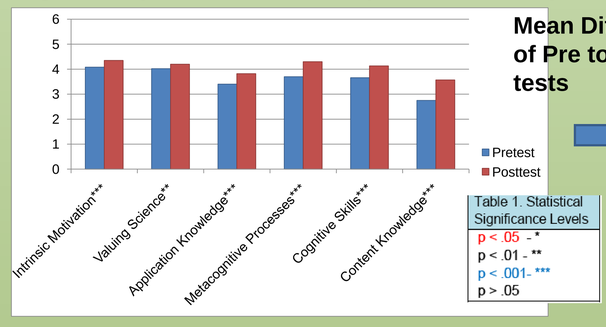
Results

Figure 1: Problem-Based Learning Graph



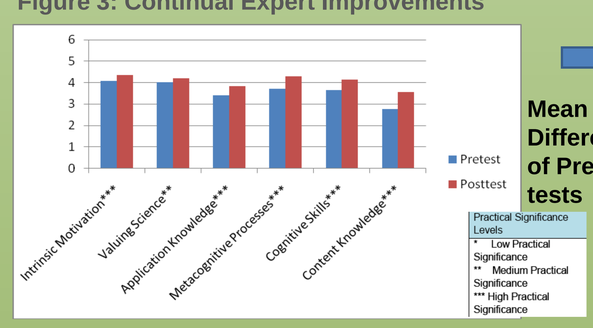
Net Gains between Pre to Post tests

Figure 2: Specific Feedback Improvements Graph



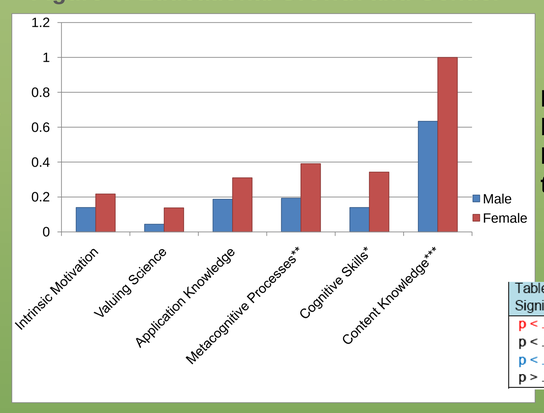
Mean Differences of Pre to Post - tests

Figure 3: Continual Expert Improvements



Mean Differences of Pre to Post - tests

Figure 4: Educational Growth and Gender



Net Gains between Pre to Post tests

Conclusions

Problem-Based Learning: The event group (control group) experienced results that were significantly lower than those of the groups that applied a problem-based teaching approach. It appears that students in the event group did not gain perceptual growth in the areas of application knowledge, metacognitive processes, cognitive skills, and content knowledge. The novice group did achieve more perceptual growth in intrinsic motivation and valuing science than other groups.

Specific Feedback Improvements: The experienced group and the expert group saw almost identical increases as they implemented the project in their own classrooms. Students in both groups exhibited significant increases in all main scales and all but two subscales. This means that the suggestions made for instructional improvement by Taylor University evaluators have successfully aided educators in improving their educational techniques to achieve growth.

Continual Expert Groups: After four semesters of implementation and feedback on how to improve, all major educational variables measured were both statistically and practically significant when comparing students' improvements from pretests to posttests. The quality of problem-based learning in science classes seem to be proportional to the number of times instructors go through the process of evaluating their classes on key instructional variables and seek to implement specific educational instructions.

References

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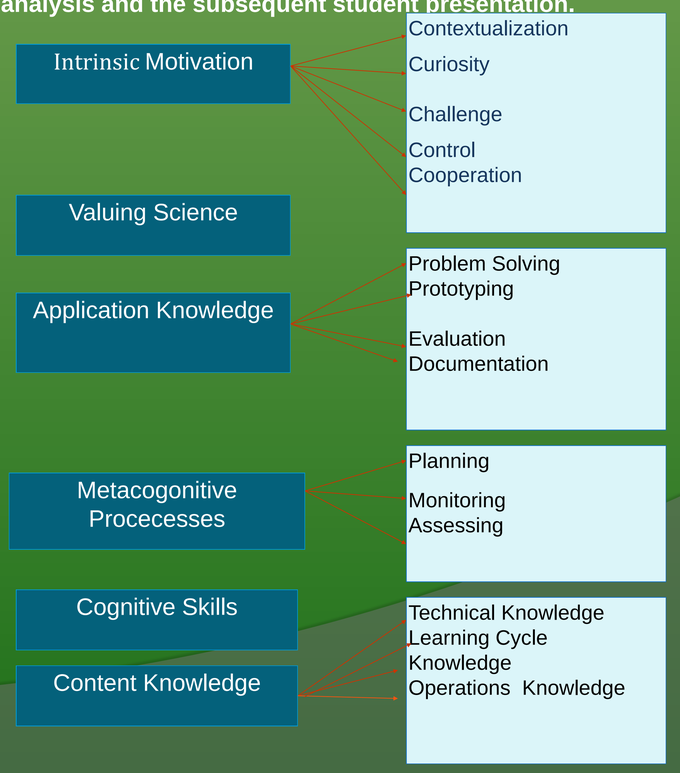
Methods

HARP Assessment Instrument

❑ 119 question survey
❑ Likert Scale (1 = Strongly Disagree, 6 = Strongly Agree)
❑ Measures student development in six primary scales with accompanying subscales.
❑ Professors administer a pre-test prior to any exposure to the ballooning project and administer a post-test after data analysis and the subsequent student presentation.



❑**Analysis**: A One-Way Repeating Measure ANOVA was used to measure changes between students' pre and post tests. Based on professors' number of HARP implementations, the classes were grouped together and One-Way ANOVA tests were conducted with a Multiple comparison Test follow-up using net gain scores. Practical significance was obtained for each comparison using η^2 to indicate the magnitude of change associated with the independent variable.

Group 1: Event Launch Group (Control group)

The control group school did not integrate the HARP program into their curriculum and conducted the launch as a one week event under the supervision of Taylor University (1 Class; 15 students).

Group 2: Novice Launch Group

The novice group included schools that had completed their 1st Balloon launch under the guidance of Taylor University during a semester course and had received feedback for improvement within the curriculum of their classes (11 Classes; 281 Students).

Group 3: Experienced Launch Group

Schools that had completed either a 2nd or 3rd launch under the guidance of Taylor University during a semester and have received feedback for improvement within the curriculum of their classes (5 Classes, 89 Students).

Group 4: Expert Launch Group

Schools that had completed more than 3 launches under the guidance of Taylor University during a semester and had received feedback for improvement within the curriculum of their classes (3 Classes; 141 Students).

Sequence of Balloon Bursting in near space