Effect of order of administration of performance assessment and traditional assessment

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Abstract

Traditional assessments, including examinations, are the most common form of assessment. At times, these are replaced or supplemented by performance tests not only as an alternative means of assessment, but also for improvement of student learning and performance. This paper presents a study designed to examine three questions. The first question was whether a performance test administered in conjunction with a traditional cognitive test result in increased learning beyond the traditional test alone as indicated by scores on the traditional cognitive test. The second question was whether the order of administration of a performance test and a traditional test result in differential learning as indicated by the combination of performance test and traditional test scores. The third question was whether the order of administration of performance test and traditional test affect knowledge retention as indicated by a final exam. For all three questions, the differences were not statistically significant and null hypothesis specifying equal effects of treatment groups in this context could not be rejected.

Keywords: Traditional tests, performance tests, order of administration, effectiveness of tests, knowledge retention

Introduction

Northern Illinois University is the second largest public university in the state of Illinois. It is a comprehensive university emphasizing both teaching and research. The college is committed to building a regional and national reputation as evidenced by its establishment of a program of Scholarship and Teaching Initiative[1] which has sponsored this study. The college formed a learning community[2] with faculty from all four departments of the college. Scarborough[3] conducted a semester long faculty development program to guide these faculty related to the initiative including development of self assessment baseline, course analysis, student centered course syllabus, multifaceted assessment System, traditional objective tests, performance assessment & rubrics etc. Gilmer[4] provided the guidance related to development of tests and assessments and their statistical analysis. One of the objectives of this program is to study the effect of teaching strategies on student learning. The initiative reinforces the philosophy about synergy of teaching and research advocated by Boyer[5] and Braxton[6].

Among various models of assessment[7], Scarborough advocated the model of performance assessment for learning[8]. In this model performance assessment played a key role. National Society for the Study of Education also mentioned that performance assessments are not

arbitrarily separated from learning and are less artificial[9]. National Education Goals Panel has noted that the performance assessments may be more closely aligned with the educational goals than the traditional tests.

Performance assessments for the proposed study were developed according to the suggestions by the National Education Goals Panel so that they have following characteristics:

1. Be open–ended. Require the students to construct a response or perform an activity.
2. Involve higher-order complex skills. These would include formulating and solving problems, reasoning and communication.
3. Require extended periods of time for performance. Include the collection and analysis of data as well as preparation of written or oral presentations of results and conclusions.
4. Involve group performance.
5. Provide some latitude in the choice of tasks.
6. Provide scoring guidelines or rubrics

Performance assessments along with traditional tests or assessments provide the necessary balance[10] in the system required for development of students' ability to perform in types of assessments where they have traditionally shown weaker performance. It may be noted that the performance assessments can be of different types[11]. In our proposed study the performance tasks may fall under the categories of written open-ended assessments and product-based assessments. Huba and Freed[12] presented how performance assessments are part of Learner–Centered paradigm which is more effective than the Teacher-Centered paradigm associated with traditional assessments. Performance assessments including advantages and disadvantages have also been thoroughly discussed by Nikto[13] .

It may be noted that while vast literature exists on performance assessments as evidenced by the above cited references, no study has been made so far on the effect of order of the performance assessment and the traditional assessment and the proposed study is undertaken to fill that void.

Course analysis and subsequent changes

During the workshop for the teaching and learning initiative, the course (Mechanical Vibrations I) was thoroughly analyzed in terms of ABET standards, NIU general education, and student learning objectives. Relation of student learning objectives to various aspects such as teaching models, teaching styles, learning styles, Bloom's[14] taxonomy and Dale's[15] cone of learning were also analyzed. Three performance tests and associated rubrics were prepared. Each test item (for both mid-term and final) was related to the student learning objectives. A detailed course calendar was prepared where topics and associated teaching model, teaching style, learning style and Bloom and Dale's Cone of learning were listed for each class period.

It may be noted that in the previous years even though ABET outcomes were analyzed for the course, they were not thoroughly analyzed in terms of student learning objectives. This course is not a university defined general education course and as such general education content analysis was not relevant for this course.

Various concepts (Constructivism, Metacognition, Scaffolding, Zone of Proximal Development, and Role of Expert performance) that apply to learning were explored in terms of their application to the course. Regarding Constructivism, even though the course format used earlier had both direct and discovery methods, it was mostly direct method. Performance tasks added more discovery method to create a balance of these two methods. Regarding Scaffolding, initial assignments had more information but later assignments had less information. Regarding Zone of Proximal Development (optimal mismatches with tasks given to students), it may be noted that for performance tasks, students initially worked individually and since they were at various stages: very rigid or stage I of Optimal Environment to adaptable or stage IV of Optimal Environment, they faced different challenges. However, when they worked together to arrive at best solution, they learned to be adaptable.

Various information processing models[16] for teaching were studied during the workshop and performance tasks involved Scientific Inquiry and Advance Organizers. Some problems in the examinations also involved Inductive Thinking. In terms of social models of teaching, performance assessments relate to both Structured Inquiry and Group Investigation. It also involved Positive Interdependence. Earlier the course was taught mostly as Direct Instruction and occasional Group Investigation (during laboratory exercises). However, the revised course not only involved Direct Instruction, but also Structured Inquiry. More Group Investigation took place because in addition to laboratory exercises, performance tasks were assigned where students started to work individually and later collaborated as a group.

Regarding teaching styles, earlier primarily command and practice styles were followed. The revised course also included Guided Discovery, Reciprocal, and Convergent Discovery. Following Kolb[17], revised course incorporated all the learning styles: Concrete Experience, Reflective Observation, Abstract conceptualization, and Active Experimentation. Analysis of the course in terms of Bloom's taxonomy revealed that earlier the course and associated homework and tests mostly involved the thinking levels of Knowledge, Comprehension, and Application. Rarely any assignment required students to analyze, synthesize and create anything. Revised course includes three performance assessments all of which required students to perform at these higher levels of thinking including the highest level of evaluation and creation. Regarding Dale's Cone of learning, earlier the course format involved more passive and intermediate learning and in the revised course, due to incorporation of performance tests, more active learning took place.

Research Questions and Design

Students in this class of fall 2006 were divided into two groups (experimental group and control group). Students were randomly assigned to these groups. Both the groups were given same instructions; however one of these groups (experimental group) was assigned a performance test two weeks before the traditional test (mid term) whereas the other group (control group) was assigned the performance test after the traditional test (mid term).

The performance task involved designing a bicycle vibration seat for comfortable ride from vibration point of view. As a first approximation, the rider along with the seat was to be modeled as a single degree of freedom model. The objective was to minimize the vibration when

the cyclist suddenly experiences an uneven terrain. Students were asked to explore typical and non typical bicycle seats, suggest some spring and damping values to make the ride comfortable and finally justify their selections.

The students had to specifically perform following tasks:

1. Define the criteria for ride comfort (displacement, velocity, or acceleration or some other factor).
2. Research information and technical specification of bicycle seats.
3. Identify specifications for a variety of road terrains (sudden change in road profile like a pothole and sinusoidally changing road profile).
4. Solve the differential equation.
5. Design the seat for comfortable ride.

Initially the students worked individually to obtain the necessary information and solve the single degree of freedom model for both kinds of road unevenness. Later the students worked in assigned groups to 1) review and critique each individual's solutions and 2) to determine the group's final suggestions (at least two) which were to be ranked in priority along with justification for the final suggestions. One report was submitted by each group which also included all individual work as an attachment.

Rubrics were prepared for grading the performance assessment. It was based on following items:

1. Research on available information on bicycle seats (local stores, internet, and patents, etc.
2. Ride quality (defined quantitatively or qualitatively).
3. Differential equation solution (free vibration with initial conditions, forced vibrations).
4. Suggestion for improved seats.
5. Report.
6. Contribution to team.

The traditional mid term examination involved questions related to classification of vibration, identifying degrees of freedom, developing correct mass-acceleration-diagram and free-body-diagram, solving for natural frequencies, undamped and damped response, and vibration isolation. The mid term questions were related to following detailed student learning objectives:

1. Discuss common vibration phenomenon.
2. Define degrees of freedom.
3. Solve particle and rigid body kinematics.
4. Decide how to choose particle and/or rigid body formulation.
5. Identify method of solution by identifying list of variables.
6. Draw free-body-diagram and mass-acceleration-diagram to solve for instantaneous forces/accelerations.
7. Convert a complex system to simple sub-systems.
8. Draw the schematic of the sub-systems.

9. Compute equivalent stiffness for springs in series and parallel.
10. Define basic vibration terminology for sinusoidal motion.
11. Obtain fourier series expansion for periodic motion.
12. Derive equation of motion for undamped translational and rotational system.
13. Solve the differential equation of motion and compute natural frequency.
14. Derive equation of motion of a viscously damped single degree of freedom system.
15. Compute critical damping constant and damping ratio.
16. Compare the undamped and damped natural frequencies and understand its relevance in terms of comparison of theory and experiment.
17. Solve for the steady state solution due to harmonic excitation.
18. Compute the total response.
19. Define transmissibility and observe the effect of damping and frequency ratios on transmissibility.
20. Solve for the response of a system due to the motion of base.

Each group had two weeks to work on the performance test. It may be noted that both groups were given the same traditional mid term at the same time. Both groups had same traditional final examination and two other performance tests. The basic design for this study is presented in the table 1.

Table 1. Performance assessment and traditional assessment administered in different order

Group 1 (experimental group)	Instruction	Performance Test (assigned Oct 9, due Oct 24)	Traditional Test (Oct 24)	→	Final Exam
Group 2 (control group)	Instruction	Traditional Test (Oct 24)	Performance Test (assigned Oct 24, due Nov 7)	→	Final Exam

The first question of whether a performance test administered in conjunction with a traditional cognitive test results in increased learning beyond the traditional test alone was addressed by comparing the means of the traditional tests.

The second question of whether the order of administration of a performance test and a traditional test results in differential learning was addressed by comparing the combined performance test and traditional test scores.

The third question of whether the order of administration of performance test and traditional test affects knowledge retention was addressed by comparing scores from the final exam on topics which were also covered on the midterm.

Results

44 students enrolled in the class were divided into two treatment groups. Group 1 comprised of 22 students who took the midterm performance assessment followed by the traditional midterm and group 2 comprised of 22 students who took the traditional midterm followed by the performance assessment.

The independent variable in this context is group assignment. The dependent variables depend on the specific research questions addressed. Statistical analyses of the results were performed using SPSS[18] for each dependent variable and they are presented in the table 2. The statistical significance levels are based on independent sample t-tests.

Table 2. Statistical analysis of dependent variables

Variable	Group	N	Mean	SD	Sig. Level (df=42)
1. Traditional midterm	1. Perf. First 2. Trad. first	22 22	41.0 41.2	8.9 14.2	0.97
2. Combined traditional midterm & performance Assessment	1. Perf. First 2. Trad. first	22 22	66.8 69.1	9.8 14.4	0.53
3. Final exam-midterm Content only	1. Perf. First 2. Trad. first	22 22	25.7 29.0	6.4 7.8	0.13

The analysis from table 2 indicates that the difference between the means of the two groups for variable 1, i.e. their scores in the traditional midterm exam, was not statistically significant beyond the 0.05 level of significance.

Similarly the difference between the means of the two groups for variable 2, i.e. combination of scores in the traditional midterm exam and the midterm performance assessment, was not statistically significant.

Table 2 also indicates that the difference between the group means for variable 3, i.e. the final exam scores for the midterm content only, was not statistically significant.

Conclusions and Recommendations

Although, for all three variables, the mean for students taking the traditional mid term first were higher than the mean for students taking the performance test first, none of the mean differences was statistically significant. This lack of statistical significance indicates that a null

hypothesis specifying equal effects of treatment groups in this context is still a viable hypothesis and cannot be rejected.

It may be noted that shortly after the semester started, there was one performance assessment which was given to all students at the beginning of the semester. Even though that performance assessment was not directly related to the midterm, critical thinking ability of all students might have possibly increased resulting in similar performance of the two groups.

Another possibility is that students worked hard for the first performance assessment and might not have spent enough time for the second performance assessment and in future the first performance assessment may be abandoned, keeping only the second (related to mid term) and the third (related to final) performance assessment to make a more definitive conclusion.

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