AC 2012-2975: ASSESSING INSTRUCTIONAL MODULES THAT ACCENTUATE STUDENT PERFORMANCE

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Mysore Narayanan obtained his Ph.D. from the University of Liverpool, England in the area of electrical and electronic engineering. He joined Miami University in 1980 and teaches a wide variety of electrical, electronic, and mechanical engineering courses. He has been invited to contribute articles to several encyclopedias and has published and presented dozens of papers at local, regional, national, and international conferences. He has also designed, developed, organized, and chaired several conferences for Miami University and conference sessions for a variety of organizations. He is a Senior Member of IEEE and is a member of ASME, SIAM, ASEE, and AGU. He is actively involved in CELT activities and regularly participates and presents at the Lilly Conference. He has been the recipient of several Faculty Learning Community awards. He is also very active in assessment activities and has presented more than thirty five papers at various assessment institutes. His posters in the areas of assessment, Bloom's Taxonomy, and Socratic Inquisition have received widespread acclaim from several scholars in the area of cognitive science and educational methodologies. He has received the Assessment of Critical Thinking Award twice and is currently working towards incorporating writing assignments that enhance students' critical thinking capabilities.

Assessing Instructional Modules that Accentuate Student Performance

Abstract

Assessment helps us understand which students learn best under what conditions. According to guidelines proposed by the American Association for Higher Education (AAHE Assessment Forum, 1992), assessment requires attention to outcomes but also and equally to the experiences that lead to those outcomes. The important aspect here is to move away from a teaching paradigm to learning paradigm. In other words, the principle is to change classroom teaching styles from a teaching environment to an atmosphere that promotes learning paradigm, and create one that leads to discovery and metacognition. The role of the instructor will be more like a facilitator of a learning environment. In their paper published in 1992, Fleming and Mills suggested four categories that seemed to identify most students' learning behavior. The facilitator should try to accommodate *VARK* learning styles for the benefit of the learners. VARK is an acronym that stands for *Visual, Auditory, Read* (includes writing), and *Kinesthetic* sensory modalities that humans employ for learning and processing information. The author has previously discussed similar ideas in other ASEE publications. The principle here is to train faculty in alternative forms of instruction if they are expected to use diverse instructional methods. The author recommends administering a *learning styles inventory* to students as a part of a regular assessment process. In this presentation the author provides how he has utilized the ideas of these researchers to assess instructional modules that can accentuate student performance in the classroom as well as in a laboratory.

Introduction

The main objective of a well designed instructional module is to ensure that the subject matter content is effectively integrated with the presentation format. In other words, the task in front of the instructor would be to blend the content and presentation in theory as well as practice. Here, the instructor assumes the role of a facilitator and effectively utilizes modern technology to experiment on innovative ideas that can lead to new classroom instructional strategies (Tozman, 2004). Authors, Alexander W. Astin, Trudy W. Banta, K. Patricia Cross, Elaine El-Khawas, Peter T. Ewell, Pat Hutchings, Theodore J. Marchese, Kay M. McClenney, Marcia Mentkowski, Margaret A. Miller, E. Thomas Moran and Barbara D. Wright developed a document in 1996 under the auspices of the AAHE (American Association for Higher Education) Assessment Forum with support from the Fund for the Improvement of Postsecondary Education with additional support for publication and dissemination from the Exxon Education Foundation.

The literature supports our intuitive belief that education in a new learning paradigm will prepare students for the work ahead of them (Cox, Grasha and Richlin, 1997). This indeed helps in raising expectations from the students. Whether it be

performance arts like theatre and music, or be it a laboratory setting like physics or biology, student performance can be effectively accentuated by adopting creative instructional lesson plans. Furthermore, many of our educational institutions have tried to move away from emphasizing the establishment of a strong knowledge-base (Young and Young, 1999).

In this paper the author discusses two models that he has successfully utilized for accentuating student performance. The first is identified as *Concept Mapping Model* and the second in identified as *Structured Content Model.*

The *Concept Mapping Model* utilizes the principles of a learning paradigm. (Tagg, 2003). The principle is to select an appropriate learning paradigm approach and preferably categorize and assign the needed information into the various components of that chosen paradigm. A model for knowledge acquisition and content delivery can be suggested however, this is normally accomplished utilizing well established and standardized building blocks of a learning paradigm (Barr and Tagg, 1995).

The *Structured Content Model* may be chosen as an alternative when the instructor finds that the *Concept Mapping Model* may not be suitable. Here subject matter content can be created independent of presentation format or delivery methodology. Regardless, this is not completely open ended and is mainly dictated by the educational objectives and course outcomes. The above principles have been discussed in greater detail by the author in his previous ASEE conference proceedings and publications (Narayanan, 2007, 2009, 2010 & 2011).

Leading scholars in the area of cognitive science and educational methodologies have stressed the importance of appropriate assessment techniques to document effective student learning.

In their 1998 book, "*Effective Grading: A Tool for Learning and Assessment"* Barbara Walvoord, Virginia Johnson Anderson and Thomas A. Angelo have provided guidelines that help educators and administrators alike.

#1: Identify traits to be considered in scoring an assignment. Traits are usually nouns or phrases that are descriptive

2: Establish a three-point or five-point scale

3: Write an explicit statement that describes performance at that level.

4: Try out the scale with samples of former student's work. Revise if needed.

Primary Trait Analysis

Catherine Palomba and Trudy Banta have provided rubrics for scoring the recording the primary traits. Uses of Primary Trait Analysis have also been documented by various authors and scholars.

1. Showing improvement over time with any of the traits or the combination of traits.
2. Providing trait-based feedback to students regarding performance.
3. Can be linked back to course objectives, including skills and values.
4. Helps the instructor identify areas of concern, strengths and weaknesses.
5. Ongoing and formative assessment of student achievement
6. Ideal for authentic assessment and course-embedded assessment
7. Program objectives can be linked across courses in the curriculum to show improvement.
8. Multiple sections can use the same form to compare learning with common assignments and exam questions.
9. Can be distributed with the assignments to inform students of the criteria that will be used to score their work.

Practices that Promote Learning

The author has discussed many of these ideas in his previous ASEE conference proceedings and publications (Narayanan, 2007 – 2011). From the literature focusing on frameworks and theories of learning, one can identify several general practices that promote learning for college students:

- Social learning experiences, such as peer teaching and group projects, particularly those that promote group construction of knowledge, allow a student to observe other students' models of successful learning, and encourage him or her to emulate them (social constructivism, self-efficacy, learning styles);
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- Varying instructional models that deviate from the lecture format, such as visual presentations, site visits, and use of the Internet (multiple intelligences, learning styles, self-efficacy);
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- Varying expectations for students' performance, from individual written formats to group work that includes writing and presentation, interpretation of theatrical, dance, musical, or artistic work, and performance of actual tasks at a work site (attribution theory, conscientization, multiple intelligences, learning styles);
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- Choices that allow students to capitalize on personal strengths and interests (self-efficacy, multiple intelligences, learning styles);
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- Overt use of sociocultural situations and methods that provide authentic contexts and enculturation into an academic disciplinary community (social constructivism, conscientization);
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- Course material that demonstrates valuing of diverse cultures, ethnic groups, classes, and genders (conscientization, learning styles).

Design of Modules

When an instructor tries to design instructional modules that accentuate student performance, the instructor should focus on five important ideas. The author has used these principles in his classroom activities and has reported on the findings in other ASEE conference presentations and proceedings. The five ideas have been reproduced here for sake of completeness and clarity.

Reaffirm: In an interactive classroom, it is important to encourage the students and engage them in a productive dialog. This is normally accomplished by asking specific questions pertaining to the topic under discussion. When a student fails to answer the instructor's question, it does not necessarily mean that the student does not possess the needed knowledge. There may be a need to *restate* the question in a different manner. It is very important to be supportive and encourage student participation. For example,

> *"That is excellent. You told me how to calculate the current in the circuit. Now why don't you continue further and tell me how to find the voltage drops as well."*

Refocus: There are instances, wherein the student may not be responding to the instructor's question correctly because they were unable to understand the multiple steps that were involved. One may need to *fine tune* the question. It is possible that there is too much information in the question. There may be a need for *narrowing the focus* so that the student is able to grasp the content that is necessary and that required by the instructor. Sometimes it is nice to lead the students through the necessary *steps.* For example,

Instead of asking:

"How do you calculate the Radius of Gyration?"

Ask:

"Can you tell me how to calculate the Moment of Inertia using the tables?"

In addition, *refocus* the question:

"Once we know the Moment of Inertia and the Mass you can tell me how to calculate the Radius of Gyration"

Revise: It is possible that the student is providing an answer that is possibly unacceptable. This may indicate that the student has not understood the question completely. The instructor should *revise* or *reword* the question and help the student whenever possible. Sometimes, the student may just need further *clarification* of a particular question. The instructor may have to *re-state* the problem. For example,

Instead of asking:

"What is the general solution for a second order differential equation ?"

Revise your question and be more specific:

"What is the solution for a second order differential equation with two unequal roots ?"

Redirect: Sometimes, the instructor has to *extract* more information from the student. The student probably has the knowledge, however, it is not being retrieved appropriately. The instructor should *verify* that the student does indeed know the intricate details. The instructor may have to redirect and remind the student to provide more details. For example,

Instead of asking:

"What is Hardness?"

Verify that the student knows the intricate details:

"What is the difference between Brinnell Hardness Test and Rockwell Hardness Test?"

Reconnect: It is the responsibility of the instructor to help develop students develop their critical thinking capabilities. In other words, help the student to *think out loud.* It is essential that the instructor is very *supportive* and actually not intimidating. Socratic Method of questioning may help, sometimes. It is essential that the students know why they are performing a given task. For example,

Instead of telling:

"x-axis should not be on a linear scale"

Make sure the student understands the need:

"Can you tell me what is the advantage of changing the x-axis to a logarithmic scale?"

Assessment and Analysis

Assessment was carried out using a rubric generated based on the principles of critical thinking. This has been shown in Appendix A.

An example of what an Assessment Bar Chart may look like is shown in Appendix B. The author chose to assess seven categories that he considered important in this study. Likert scale analysis was carried out and mode values have been plotted on the x-axis.

Referring to the bar chart shown in Appendix B, one can draw these conclusions.

None of the characteristics observed scored the maximum possible likert scale score of **5.** We should also point out the fact that none of the characteristics observed scored the minimum possible likert scale score of **1.**

A likert scale score of **4** was recorded for the following:

- Providing Feedback to Students
- Course Objectives, Skills and Values.

The author is of the opinion that both of these should have documented a score of **5.** The author has clearly outlined the course objectives in his syllabi and he makes sure he provides necessary feedback to the students at regular intervals. Even though a score of **4** is quite acceptable, the author considers this to be inadequate. The author will revisit and revise as appropriate.

A likert scale score of **3** was recorded for the following:

- Improvement over time
- Assessment of student achievement
- Program objectives

Again, the author is of the opinion that this is not acceptable. A likert scale score of **3** is totally inadequate. Structure of the syllabus needs to be re-examined and re-designed. The instructor should improve this score to a minimum acceptable level of **4.**

An unacceptable likert scale score of **2** was recorded for the following:

- Concerns, strengths and weaknesses
- Course embedded assessment

This again, needs thorough re-examination. Modules may have to be redesigned and reevaluated. The instructor should try hard to improve this score to a minimum acceptable level of **4.**

Conclusions

At Miami University, the author utilizes a variety of instructional tools in addition to simple and routine lectures. These include, but not limited to audio-visual aids, power point presentations, tutorials, problem-solving sessions, written research reports, peer group discussions, oral presentations, internet research, etc. He has also tried to implement ideas generated by some of the leading scholars in the area of Cognitive Science (Narayanan, 2007 – 2011). The author tries to expose students to information that is available from a variety of different sources. The author believes that this methodology would help the instructor communicate with those selected group of students who may prefer to respond to a different learning style. In other words, the author encourages diverse modes of learning techniques. The author also recommends that students should utilize the additional resources that are readily available at the university, such as Library, Writing Center, Help Desk, etc. The author would also like to state that *Washington State University's Critical Thinking Rubric* has proved to be extremely valuable in documenting the effectiveness of this study. The ultimate goal of any instructor should be to deliver information to students in the best possible manner that suits the receiver's optimum learning style.

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APPENDIX A : Critical Thinking Rubrics (Courtesy of W.S.U., Pullman, WA)

LIKERT SCALE: 5: STRONGLY AGREE 1: STRONGLY DISAGREE

5	Has demonstrated excellence. Has provided documentation. Evidence of critical thinking ability. Very good performance	Has analyzed important data precisely. Has answered key questions correctly. Has addressed problems effectively. Has evaluated material with proper insight. Has used deductive reasoning skills. Has used inductive reasoning skills. Has employed problem solving skills. Has discussed consequences of decisions. Has been consistent with inference.
3	Has demonstrated competency. Adequate documentation. Critical thinking ability exists. Acceptable performance.	Data analysis can be improved. More effort to address key questions. Need to address problems effectively. Expand on evaluating material. Improve deductive reasoning skills. Improve inductive reasoning skills. Problem solving skills need honing. Must discuss consequences of decisions. Has been vague with inference.
1	Poor, unacceptable performance. Lacks critical thinking ability.	Absence of analytical skills. Answers questions incorrectly. Addresses problems superficially. Lacks documentation. Inability to evaluate material. Shows no deductive reasoning power. Inductive reasoning power non existent. Poor problem solving skills Unaware of consequences of decisions. Unable to draw conclusions.

Source: Critical Thinking Rubric, Washington State University, P.O. Box 644530, Pullman, WA 99164 - 4530 USA.(2005) http://wsuctproject.wsu.edu/ctr.htm

APPENDIX B : What an assessment bar chart may look like