Authentic Assessment Using Student Portfolios

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Introduction

Clearly, all levels of education are moving towards a standards based form of assessment of student learning. At the K-12 level, State Departments of Education are leading the way by creating specific standards and using norm and criterion referenced standardized tests to ensure that minimum standards are met. At the university level, accrediting bodies, including the Accreditation Board for Engineering and Technology (ABET), have revised the criteria for accrediting programs. The new approach shifts emphasis away from what is being taught to what is being learned and is less proscriptive of required coursework [1]. Learning outcomes are now based on what students should know and be able to do in order to prove they are competent in both university and professional standards. But many questions remain regarding the best way to assess standards based student learning and aligning the numerous standards set forth by university, professional and regional accrediting bodies.

In many professions, including some associated with the fields of engineering and technology, *portfolio* is a familiar term. Portfolios have constituted the primary method of evaluation in fields such as art, architecture, modeling, photography and journalism for many years. In education, a portfolio can be defined as a purposeful, systematic process of collecting and evaluating student products to document progress toward the attainment of learning targets or show evidence that a learning target has been achieved [2, 3].

Published examples of student portfolios for assessment of engineering and technology education outcomes are sparse. Some institutions use portfolios to measure how overall curricular objectives are being met, but not as a learning tool for individual students. Colorado School of Mines began collecting and assessing student portfolios in the late 1980's as a response to a state mandate for educational outcomes assessment, and this process has been adapted to assessment of ABET outcomes [4]. Since fall 1998, students at Rose-Hulman Institute of Technology have been asked to maintain electronic portfolios that document their progress toward achieving ABET outcomes related educational goals [5]. More recently, a study conducted at Worcester Polytechnic Institute attempted to determine if student portfolios could be simultaneously useful for program outcomes assessment, helpful for student learning and logistically feasible [6].

With the advent of standards based assessment of student learning, many universities are developing their own principles of undergraduate learning in an effort to ensure that

students have met specific learning outcomes. In addition, nearly every professional school (engineering, law, medicine, education, etc) is accredited by their own professional accrediting agency, and often, universities are accredited by a regional accrediting agency (NCA, SACS, etc.). In many cases degree granting programs confront three separate sets of standards: 1) university, 2) professional, and 3) regional/national Alignment of these standards can be a lengthy task, and dissemination of the alignment to students so that they are aware of and understand their learning targets is an even larger task.

This paper describes a pilot project executed at Indiana University Purdue University Indianapolis in which students constructed learning portfolios based on university, professional and regional accrediting body learning outcomes. The intent of this project was to recruit students pursuing a four-year degree in any discipline or department from the Purdue School of Engineering and Technology at Indiana University Purdue University Indianapolis (IUPUI) and have them participate in a pilot program using portfolio based assessment as a means to show evidence that the IUPUI Principles of Undergraduate Learning (PUL's) and ABET TAC and EAC Criteria A through K had been mastered.

The Pilot Program

The School of Engineering and Technology at Indiana University Purdue University Indianapolis awards a number of Assessment Grants to faculty in an effort to ensure continued research in the area of student assessment. This pilot program was designed as a result of this author receiving one of the Assessment Grant awards for 2002. The Pilot Program titled Authentic Assessment Using Student Portfolios began in May of 2002 and concluded in May of 2003.

Participation in the pilot program was open to any degree seeking student who met the following criteria:

1. Full-time, degree seeking students in the IUPUI of Engineering and Technology;
2. Juniors in good standing with a 2.0 overall GPA or better;
3. Willing to meet with fellow group members approximately two hours per month from September, 2002 through May, 2002;
4. Willing to devote approximately five hours per month of time to organize and complete portfolio requirements;
5. Willing to explain/defend the exhibits in their completed portfolios to professors, administrators, students and staff.

Upon successfully completing the requirements for the pilot project, students received;

1. $300.00 deposited in their bursars account to be used to pay off debt accrued from that account or to be rebated to the student in cash or check provided the bursars account was paid in full;
2. One to three credit hours for completion of OLS 399: Portfolio Assessment,

which was a special topics course offered by the Department of Organizational Leadership and Supervision;
3. An opportunity to provide input to the IUPUI ePortfolio development committee regarding the creation of a user friendly electronic portfolio.

The Assessment Grant called for a number of project objectives to be developed in an effort to focus the pilot project. After consultation with and input from the Dean, Department Chairs, faculty and students of the School of Engineering and Technology, the project goals were developed:

1. To create a tool for authentic assessment of student proficiency, skill, style and talent using national accrediting agency standards and the IUPUI Principles of Undergraduate Learning as minimum learning standards.
2. To ensure that the creation of a tool for authentic assessment of student performance is compatible with current efforts to assess student performance by the IUPUI School of Engineering and Technology and the university ePortfolio initiative.
3. To involve students in the creation of an authentic assessment tool that serves as a pilot for a portfolio assessment that will prove useful to School of Engineering and Technology and IUPUI academic programs.
4. To create a tool for authentic assessment that meets the goals of the Department of Organizational Leadership and Supervision in the area of assessment.

The specific plans and timeline for development and implementation of the pilot program were delineated as follows:

May -- August, 2002 -- Meet with faculty and administration from the School of Engineering and Technology to gather input regarding the pilot project. Specifically, meetings with members of the School of E & T Assessment Committee and the University ePortfolio Committee will shed light on the direction of the portfolio program. Specific standards (PUL's, ABET, Program, School) will be agreed upon and used as the framework for the portfolio. The ability to ensure compatibility with ePortfolio exhibits will also be discussed and agreed upon during this phase of the project.

August -- October, 2002 -- A "call for students" will be issued. Any E & T student who wishes to participate in the development of a student assessment portfolio will be requested to attend an organizational meeting. To participate, students must be juniors in good standing with a minimum of a 2.00 GPA and a recommendation from their department chair. Students must commit to producing a completed portfolio within 12 months and/or upon graduation from their respective academic program. Students must agree to attend monthly meetings and work as a team to develop portfolio exhibits based on agreed upon standards. Upon completion of their portfolio, students will receive a $300.00 stipend .

November -- May, 2002-03 -- Students will attend monthly meetings to gain a clear

understanding of the standards to be assessed, develop the exhibits that will prove proficiency/mastery of those standards and complete self reflection (meta-cognitive papers) assignments detailing what they have learned throughout their undergraduate program and why they believe the particular exhibit they have chosen represents proficiency/mastery of the standard. In addition, students will work with peers to discuss advantages/disadvantages of the portfolio assessment tool.

May -- June, 2003 -- Students will "defend" portfolios before a panel of faculty, advisory committee members, deans, grad students or other interested parties. The defense will consist of a short power point presentation regarding the finished product and a period of question and answer regarding the portfolio itself. Students completing the project and successfully defending their portfolios will receive credit for taking OLS 399, which is a special topics course. The course title will be "Portfolio Assessment."

A total of 10 students entered into the pilot after a "call for students" was distributed to all School of Engineering and Technology faculty and students explaining the project criteria and expectations (see appendix 1). An orientation was held in August of 2002 inviting all interested students and 13 students attended. After students had completed the orientation session and asked questions, a total of 10 students indicated that they wanted to participate. These 10 students completed a Student Data Form (see appendix 2). Nine were majors from the School of Technology and one was from the School of Engineering. A variety of majors were represented and the initial ten students were very diverse in terms of background (see table 1).

Table1

Field1	Field2	Field3	Field4	Field5	Field6	Field7
Participant	Gender	Race	Major	GPA	Aware of PUL's	Aware of ABET
James	Male	Caucasian	Computer Tech	3.9	Yes	No
Wilma	Female	Caucasian	Computer Tech	2.6	No	No
Sonny	Male	Afro-American	Computer Eng	2.9	No	No
Andrew	Male	Caucasian	Org Leadership	3.0	No	No
Betty	Female	Afro-American	Org Leadership	3.7	No	No
Charlie	Male	Caucasian	Org Leadership	2.5	No	No
Evelyn	Female	Caucasian	Org Leadership	3.2	No	No
Maria	Female	Hispanic	Org Leadership	2.95	No	No
Renaldo	Male	Caucasian	Org Leadership	2.9	No	No
Sámi	Female	Asian	Org Leadership	2.8	No	No

Data Collection and Analysis

The major objectives of the research portion of this study were to develop a deep understanding of the development of a student portfolio based on university and professional standards. In this case, The Principles of Undergraduate Learning developed

by a campus-wide committee of faculty, administration and staff at Indiana University Purdue University Indianapolis served as the university based learning outcomes. The study was designed to discover and explore: 1) barriers to the development of student portfolios, 2) how those barriers might be overcome, and, 3) recommendations for students and instructors using portfolios as a means for student assessment.

The portfolio assessment project was explained in detail to each of the ten participants and they completed a Student Data Form and signed a Consent Form indicating their willingness to consent to an in-depth interview to determine barriers to the development of their student portfolios (see appendix 3). Data was gathered from the Student Data Form and a series of interviews that started before the project began, continued during the project and ended when the project was over.

The exploratory nature of this study necessitated a very small number of participants. A total of ten individuals participated in this research. This sample size is approximately the same as has been used in similar qualitative studies performed by Boyle (1994), Clark (1991), and Reidling (1996) [7, 8, 9]. A fundamental assumption in this exploratory research was that each individual would perceive the portfolio assessment experience somewhat differently. As a result, the data were the subjective perceptions of the participant's reality as articulated to, and understood by the researcher. Typically, in the phenomenological investigation the long interview is the only source of data collection. However, some exploratory and phenomenological researchers have added other methods of data collection in keeping with qualitative research traditions [10]. For purposes of this study, in-depth interviews were used as the primary form of data collection and those data were supplemented by researcher observations and written data completed by the participants (See appendix 1, 2 and 3).

In discussing the phenomenology as a research strategy, Strauss and Corbin (1990) believe that phenomenological research into learning seeks to enter the existential reality of the learners so that the assumptions, reasoning processes and belief systems informing their perception of the world can be appreciated. The purpose is to enter another's frame of reference in such a way that the person's structures of understanding and interpretation, and the perceptual filters through which the person apprehends reality, can be experienced and understood by the researcher as closely as possible to the way they are experienced and understood by the learner [11]. As a result, study participants must be carefully chosen individuals who have the frame of reference to comprehend the phenomenon and share their experiences with the researcher. In additions, the research methodology chosen for this study uses multiple rounds of interviews with the same individuals rather than sampling large numbers of the population. Due the purposeful sampling, small number of participants, and other limitations of exploratory research, the results of this study should be used primarily to inform and stimulate future research.

Several rounds of in-depth interviews were conducted with each participant. Interviews were audio-taped and responses were compared after each round of interviews. Three questions were asked of each participant: (1) What barriers did you encounter

during the development of your student portfolio? (2) What coping/adapting strategies did you develop or utilize to overcome those barriers? (3) Based on your experience, what recommendations would you have for students and instructors using portfolios as a means of student assessment. An analysis of the responses led to more questions and these served as the basis for the next round of interviews. After informational redundancy was achieved, the results were analyzed using Moustakes' protocol. This eight step process includes: (1) listing and preliminary groupings, (2) reduction and elimination, (3) clustering and thematizing the invariant constituents, (4) final identification of the invariant constituents and themes by application, (5) using the relevant, validated invariant constituents and themes by application, (5) using the relevant, validated invariant constituents and themes, construct for each co-researcher (study participant) an individual textural description of the experience, (6) construct for each co-researcher (study participant) an individual structural description of the experience based on the individual textural and imaginative variation, (7) construct for each research participant a textural-structured description of the meanings and essences of the experience, incorporating the invariant constituents and themes, and (8) from the individual textural-structural descriptors develop a composite description of the meanings and essences of the experience, representing the group as a whole [12].

Findings and Discussion

For purposes of this paper, the findings discussed will center on barriers to the portfolio process. As delineated earlier, educational portfolios are usually created around a set of standards or outcomes. In the case of this group of students, it was clear that the primary barrier to the development of their portfolios was the fact that they had no concept of the university or ABET standards. Not only did the Student Data Forms prove this, but each student who was interviewed indicated that lack of knowledge/awareness of the standards was a primary barrier to the successful creation of their portfolio.

Of the ten students that participated in this study, all were given a Portfolio Assessment Student Data Form (see appendix 2). Question #1 on the form asked if students were "…familiar with the IUPUI Principles of Undergraduate Learning." Question #2 asked if students were "….familiar with ABET and the accreditation standards for engineering and technology programs." Nine of ten students responded that they were not familiar with the IUPUI Principles of Undergraduate Learning and ten of ten students responded that they were not familiar with ABET or the accreditation standards for engineering or technology programs. While the small number of participants in this exploratory study do not allow for these finding to statistically significant, the data are indicators. And as is often the case in exploratory studies, more questions than answers are sometimes brought to light. Certainly, the simple fact that nine of ten students did not even have knowledge of the existence of learning standards developed by the university and ten out of ten students had never heard of ABET as an accrediting agency for school of engineering and technology speaks volumes about the barriers to successful portfolio development.

Quality portfolio assessment programs must begin by educating students about the standards movement at both the university and national level. Students can't produce

what they don't know about. Learning standards or principles developed at the university level often do not involve students and therefore the process excludes important stakeholders that are later expected to "prove competence" in those standards. If the standards movement is to become a part of the university climate and culture, it is important for students to be involved from the beginning in the development process of the university standards and in the authentic assessment of those standards. Too often, the creation of university standards is left to faculty who do not truly embrace the process or the standards, and therefore do not use them as a part of their teaching or include them in the course syllabus. The danger of not having a "student voice" during the development of university learning standards/principles is that neither faculty nor students can then be held accountable for proving proficiency in those standard/principles.

A second barrier was the lack of awareness of national ABET standards. All students in this study had no idea what ABET was, what it did, why it existed and how the ABET standards for accreditation were developed. This lack of knowledge was due to a number of factors, the primary being no exposure. Whether a university has developed standards or not, ABET TAC and/or EAC criteria A through K, must be met for an engineering or technology program to be accredited. Often departments undergoing ABET accreditation use student work, satisfaction surveys, and business and industry data to prove they have met competence in criteria A through K, but rarely do they make students and business and industry aware of ABET and the criteria necessary for accreditation. ABET standards are rarely included in syllabi, course discussion and extra-curricular activities. Both universities and ABET could do much more to publicize the move to standards based accreditation and teach student stakeholders how to meet competence in those standards.

A third barrier was the fact that students were unaware that much work had been done at the campus level to align the university Principles of Undergraduate Learning (PUL's) with ABET standards TAC and EAC A through K. An assessment committee in the School of Engineering and Technology at IUPUI worked for nearly two years to align IUPUI and ABET standards. They created an ABET/PUL Outcomes Matrix for both EAC Criteria #3, items A through K, and TAC Criteria #1, items A through K (see appendix 4). A large amount of time was spent during the initial stages of the Pilot Project discussing the history of the aforementioned assessment committee, the development of the outcomes matrix, and how that matrix might serve as the template for portfolio exhibits that students would create. As was the case with the IUPUI Principles of Undergraduate Learning and ABET Outcomes Criteria, the participants in this pilot project had no idea that an assessment committee existed, much less the fact that this committee had created a detailed matrix that aligned university and professional outcomes.

In this study, the entire Fall semester was devoted to gaining a clear understanding of the IUPUI Principles of Undergraduate Learning and ABET standards A through K. Once these barriers were overcome, students produced a quality portfolio based on a matrix developed by the School of Engineering and Technology Assessment Committee titled "PUL/ABET Outcomes Matrix." This matrix was developed to provide a map linking common outcomes/standards between the Principles of Undergraduate Learning and

ABET Outcomes. Once students were made aware of this matrix, they developed an exhibit template detailing the exhibit title, PUL and ABET standards met through this exhibit, and an explanation of why the student felt this exhibit proved their competency in the required standard.

Conclusion

Clearly, the standards based movement is here to stay. Universities and accrediting organizations expect students to know and be able to do more, and prove competence in the standards that have been developed. However, students must first be exposed to the standards, made aware of the specific expectations and then be guided through the process of authentically assessing their individual competency in each standard. Attempts at aligning university, professional and accrediting body standards must be embraced by faculty, students, administration, external constituents and accrediting bodies. Universities must provide the proper resources for this process to happen and accrediting bodies must develop a higher profile within the student base so as to promote the standards based movement and subsequent authentic assessment of those standards.

As is often the nature of exploratory research, this study created far more questions than it answered. These questions include: How can students be invited as stakeholders into the accreditation process? How can university, professional and regional standards be aligned to avoid duplication and repetition of the accreditation process? What additional barriers exist to the development of portfolio based assessment of student learning?

Students in this study indicated that barriers exist during the creation of student portfolios to assess student learning. Further research must be conducted to determine how these barriers might be overcome and how universities can ensure that future endeavors in this area have the necessary resources to be successful.

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Biographical Information

Charlie Feldhaus is an Assistant Professor of Organizational Leadership and Supervision with the Purdue School of Engineering and Technology at Indiana University Purdue University Indianapolis. He teaches Ethics and Leadership Theory and his research interests include distance education, assessment and organizational safety and security.

APPENDIX 1

CALL FOR STUDENTS!

Any student currently seeking a B.S. degree in *any* Engineering or Technology program within the School of Engineering and Technology at IUPUI and who:

1. **Would like to organize their course work, professional work and life experience into a useful portfolio;**
2. **Is willing to meet with fellow group members for approximately 2 hours per month from September, 2002 through May, 2002;**
3. **Is willing to devote approximately 5 hours per month of time to organize and complete portfolio requirements;**
4. **Is willing to explain the exhibits in their completed portfolio to professors, students and staff in the School of Engineering and Technology;**
5. **Needs $300.00 (upon successful completion of the project);**
6. **Would like credit for OLS 399 (free of charge);**
7. **Is interested in learning more about this project;**

SHOULD ATTEND THE FOLLOWING MEETING:

LOCATION: **ET Room 324**
TIME: **12:00 Noon to 1:00 p.m.**
DATE: **Wednesday, September 4**

LUNCH WILL BE SERVED!

APPENDIX 2

PORTFOLIO ASSESSMENT PROJECT
STUDENT DATA FORM
(please print)

NAME_____

EMAIL ADDRESS_____

TELEPHONE_____

MAILING ADDRESS_____

_____

GENDER _____

RACE_____

GRADE POINT AVERAGE _____

Are you familiar with the IUPUI Principles of Undergraduate Learning?

Yes or No (please circle one)

If above answer is yes, please specifically describe what the IUPUI Principles of Undergraduate Learning are:

_____
_____
_____
_____
_____
_____

Are you familiar with Accrediting Board for Engineering and Technology (ABET)?

Yes or No (please circle one)

If above answer is yes, please specifically describe what the ABET organization is responsible for and what the ABET accreditation standards for engineering and technology are:

APPENDIX 3

CONSENT FORM

I agree to participate in the following study entitled "Authentic Assessment Using Student Portfolios." I understand that participation is voluntary.

The following has been explained to me:

1. The identity of the Principal Investigator of this study:
   Charles Feldhaus, Ed.D.
   Assistant Professor of Organizational Leadership and Supervision
   Purdue School of Engineering and Technology
   Indiana University Purdue University Indianapolis

2. The purpose and importance of this study; that it is conducted with a unique population, that it will greatly contribute to the limited research regarding the use of Student Portfolios as a means of authentic assessment.

3. The fact that upon completion of my portfolio for this project, I will be eligible for a $300.00 stipend.

4. That as part of the study I will be asked to complete the self-scorable Myers-Briggs Type Indicator instrument.

5. That upon completion of the portfolio I will be interviewed by the principal investigator for approximately 30-60 minutes.

6. That during the interview I will be asked three questions: 1) What barriers did you encounter during the development of your student portfolio? 2) How did you overcome those barriers? 3) What recommendations would have for students and instructors using portfolios as a means of student assessment?

7. There may be the need for a second 30-60 minute interview to ask clarifying questions based on answers given during the first interview.

8. There is no anticipated discomfort or stress accompanying this research.

9. There are no risks involved in participating in this study and student grades will not be affected by my participation.

10. My identity will be kept confidential and for reporting purposes, a pseudonym will be used to further protect my identity.

11. The researcher will answer additional questions about the study at any point.

12. I may voluntarily withdraw from this project at any point.

_____ _____

Participant Principal Investigator

APPENDIX 4

TABLE 2. PULS COVERED BY ABET/EAC CRITERION 3, ITEMS A-K

Created by David Bostwick, Oct. 15, 1999

Revised by Hasan Akay and Charlie Yokomoto, May 21, 2002

3 = strong linkage, 2 = moderate linkage, 1 = mild linkage

ABET/EAC CRITERIA #3, items a through k	PULs COVERED BY THE ABET/EAC a-k																					
	PUL 1					PUL 2					PUL 3			PUL 4			PUL 5			PUL 6	
	Core Communication and Quantitative Skills					Critical Thinking					Integrate and Apply Knowledge			Intellectual Depth, Breadth, and Adaptation			Understand Society and Culture			Values and Ethics	
	a	b	c	d	e	a	b	c	d	e	a	b	c	a	b	c	a	b	c	a	b
(a) - An ability to apply knowledge of mathematics, science and engineering				3		2	2		2	2	2	3	2	3	2						

(b) - An ability to design and construct experiments as well as to analyze and interpret data						3	3	3	2			2		3	1	2					
(c) - An ability to design a system, component, or process to meet desired needs						2	2	3	3	1	3	2	3	3		3					
(d) - An ability to function on multi-disciplinary teams			2												1	3			2		
(e) - An ability to identify, form & solve engineering problems		2		3		3	3	3	3	3	3	3	3	3	1	2					
(f) - An understanding of professional and ethical responsibility						2	3					2	1		3	2	1	1	2	3	1
(g) - An ability to ommunicate effectively	3		3																		
(h) - The broad education necessary to understand the impact of engineering solutions in global societal context											1	2	2			2	2	2		2	

(i) - A recognition of the need for and an ability to engage in life-long learning		3			2		2													
(j) - A knowledge of contemporary issues		2								1					1			2			2
(k) - An ability to use the techniques, skill and modern engineering tools necessary for engineering practice					3							3	2	3							