The Pedagogical and Andragogical Validity of Capstone Projects

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Abstract

Non-traditional students have been the mainstay of regional and satellite university campuses for many years. Purdue University's Anderson, Indiana site is no exception. In an effort to maximize the educational experience of these adult learners, the faculty has experimented with several different instructional methodologies. Some of these experiments have proven successful while others have not. In order to better develop these instructional methods, the authors have researched adult and child learning and developed a set of assumptions about each. These assumptions have been used to direct the development and application of different instructional methodologies.

Recently, the Anderson campus of Purdue University has experienced a significant increase in its traditional student population. These traditional students do not seem to perform as well when methodologies designed for non-traditional students are employed. The faculty found it necessary to re-visit the basic assumptions regarding traditional and non-traditional learners. This re-visitation became the catalyst for a re-evaluate of their instructional methodologies. They began a search for instructional techniques that would produce good results in mixed groups of learners.

This paper will review the basic assumptions about adult and child learning and present a comparison and contrast of the two. Based upon the assumptions presented, the paper will illustrate how the capstone project methodology can produce good results in a mixed group of traditional and non-traditional learners. A data communications course example of the capstone project methodology will be presented to illustrate the technique.

I. Introduction

The application of technology in the workplace has had a great impact on the types of activities workers perform. As technology changes the workplace, workers need to change. These re-tooling workers have been a significant portion of the student population at regional and satellite university campuses. Purdue University's School of Technology at Anderson program is an example of this. At one time, non-traditional students comprised over ninety percent of the student body of this campus. These non-traditional students averaged over 30 years old and worked full time. These students were adult learners, had special learning needs, and required special teaching methodologies to maximize their learning. In the United States, Malcolm Knowles introduced the andragogy method, defining it as "the art and science of helping adults learn". Knowles' primary premise is that virtually all adult learning is self-directed through one's life-based roles, experiences, and interactions.[1]

Recent changes have shifted the composition of the student population of Purdue's Anderson campus. While the non-traditional student population has remained fairly constant, there has been a significant increase in the number of traditional students enrolled at the campus. Several causes for this increase have been identified.

Recently graduated students from local high schools have identified the Purdue Anderson campus as a vehicle that will allow them to attend college without the expenses of moving to a traditional campus. Many of these students also work, either full of part-time, to finance their education. It is important to differentiate these working traditional learners from non-traditional learners. While many of these students are employed, they have not formally entered the workforce with a career mindset. Most view their employment in much the same manor as they did their high school part time jobs. They still consider themselves primarily students and are not in a career path.

Another group of traditional students beginning to use the Anderson facility are university students who cannot get majors or courses they desire at the conventional campus locations. Demand for courses at Purdue's main campus in West Lafayette, IN has exceeded the available resources. Students are finding that courses and majors that are closed at main campus are available at Anderson and other regional campuses. Similar situations have occurred at other universities in the area, and students from these institutions are using Purdue's Anderson facility to continue their education until courses and majors they desire are available.

Purdue Anderson has also seen an increase in traditional students that do not fall into any of the above categories. These students are enrolled because they are not emotionally prepared to move to a conventional university campus. These students can remain close to their families and hometowns, easing the transition from high school to the university.

These sources have contributed to a significant increase in the traditional student population at the Anderson campus. This increase has resulted in a mixing of traditional and non-traditional students in courses. This mix has forced the faculty to re-examine their approaches to teaching.

Lecture, recitation, structured laboratory exercises, and other methods that have been employed by universities for years were not successful with non-traditional students. The faculty at Purdue Anderson has spent considerable resources researching and developing instructional methods that produced good results with adult learners. However, instructional methods that have proven successful with non-traditional students have been less successful with this new influx of traditional students. The faculty revisited their initial research and the assumptions they developed about traditional and non-traditional learning in an attempt to identify methods that would produce good results for both groups of learners.

II. Pedagogy versus Andragogy

A comparison of the two educational approaches of pedagogy and andragogy is critical to fully understanding the importance of the selection of the proper instructional methodology for maximized learning. Pedagogy is defined as "the art and science of teaching children".[2]

Andragogy is defined as "the art and science of helping adults learn".[2] The key here is teaching, what the teacher does, versus learning, what the student retains.

The pedagogy methodology incorporates the following assumptions:

- The learner is dependent on the teacher, who makes nearly all decisions.
- The learner brings little value to the learning experience, promoting lecturing as the most common technique for transferring knowledge.
- The learner is ready to learn when told by the teacher to be ready to learn.
- The subject matter is presented and subject centered.
- Motivation to learn is extrinsic.

The andragogy methodology assumes the following:

- The adult learner is independent, should be in charge and capable of taking personal responsibility for self-directed learning.[3]
- The adult learner has many high quality life experiences that valuable are and should be used as resources in experimental teaching techniques, group discussions, and teamwork.
- Adult learners learn when their life or work situations dictate that they need to acquire information to deal with specific circumstances.
- Subject matter for adult learners should be life, problem, or task centered.
- Adults learn because they want to, with the majority of motivation being intrinsic.[4]

Malcolm Knowles advises that these sets of assumptions about pedagogy and andragogy are not independent of each other. They represent opposite ends of a continuum. Knowles concedes that some adults learn better under the pedagogy method and some children benefit from an andragogy method. However, he advises that the vast majority of adults will achieve better results from the andragogy methodology. Concurrently, the majority of children will learn best when the pedagogy methodology is applied.[5] Although the new traditional students are not children, virtually all of their educational experiences have followed the pedagogical approach. In most instances, they are not mature enough and lack the life experiences needed for the self-directed nature of the andragogical approach.

III. Instructional Methods Analysis

Based on the andragogical assumptions outlined above, the faculty at Purdue's Anderson campus experimented with a variety of instructional methods directed primarily toward the adult students, which represented the majority of the population of the campus at that time. Methods such as self-directed projects, independent study, and learning contracts[6] were particularly successful. As the traditional student population began to increase, these andragogy-based methods proved less effective in the classroom.

The faculty found it necessary to search for methods that could perform at acceptable levels in both the traditional and non-traditional student populations. Given the dipolar nature of the learning assumptions for these two groups, this appeared to be a difficult, if not impossible, task. Since there exists a vast number of models for pedagogy methods at university campuses worldwide, this seemed to be the best starting point for the search. The faculty compiled a list of

instructional methods used in courses being successfully delivered to traditional students. These successful pedagogical methodologies were then compared to the andragogy assumptions, to assess their applicability. Another technique used by the faculty was to use their classroom experience and research to compile a second list containing successful andragogical methods. It was this technique that produced a surprising match. The capstone project method appeared on both lists.

IV. Capstone Project Methodology

Capstone projects have been widely used in the conventional university setting as a pedagogical method. Students must develop a comprehensive solution to a complex problem by first identifying the key components of the problem, and then designing a system to overcome those problems and achieve the specified goals. The capstone project encompasses many of the topics covered in the course, and frequently in prerequisite courses. Since the project is not directly tied to the current lecture or laboratory topic, students can take no clues from these to assist in problem identification and solution. Students employ a zero-based solution design methodology, working with a minimum of supervision and direction.

Bloom has developed a widely published and accepted taxonomy for the cognitive domain. His taxonomy consists of six levels of learning: 1) Knowledge 2) Comprehension 3) Application 4) Analysis 5) Synthesis 6) Evaluation.[7] Capstone project methodology spans the complete range of Bloom's taxonomy. It requires knowledge of the subject at hand, the facts and terminology presented in the course (Knowledge). It also requires an understanding of what the facts and terminology mean (Comprehension). Students must be able to determine what knowledge is relevant and applicable to the project (Application). Students must be able to analyze the problem to identify the key and mitigating factors (Analysis). Students must be able to extrapolate existing knowledge to synthesize a solution to this new problem (Synthesis). Finally, the student must evaluate his or her solution to determine if it meets the criteria specified in the project (Evaluation).

When compared against the pedagogy assumptions previously stated, the capstone project fits well. The learner is dependent on the teacher to provide the problem and the criteria for the solution. All necessary learning has been accomplished through the proceeding lectures, so no life experience is needed. The student is given a specific starting and completion date, thus the student learns 'when told'. The subject matter directly parallels the course content, which has been presented in the course and its prerequisites. Finally, students view this as another evaluation mechanism, like an exam. They complete the project because they are told to do so.

The capstone project also fares equally well in a comparison to the above andragogy assumptions. The minimal supervision and direction aspect of the project allows the adult learner to feel in charge and self-directed. The adult learner can bring life experiences as well as lecture knowledge to his or her solution. Adult learners will be motivated to assimilate new material not learned in the lecture because they now feel they need that knowledge to complete the project. The entire project is problem and task centered. The adult learners take personal ownership in their projects, and thus are intrinsically motivated. The open nature of the capstone project methodology allows them to share information and learn from others in the class.

V. An Application Example

The Computer Information Systems and Technology (CPT) faculty at Purdue's Anderson campus have implemented the capstone project methodology in a 200 level, laboratory-based data communications course. The Anderson campus offers only A.S. degree in CPT so the 200 level data communications course represents the culmination of course work for CPT students at the site. Students receive the capstone project in week twelve or thirteen of the sixteen week semester. In week sixteen, the students give an oral presentation outlining their proposal. This presentation, along with a written proposal, represents the final examination.

Specifically, students are given a local area network (LAN) problem. The scenario includes a group of existing LAN segments, along with several additional computers that need to be connected to the LAN. Performance criteria and data exchange capabilities are specified. The faculty is careful to include one unique or non-standard aspect to the connectivity. Without this the students might stumble into a correct solution by merely proposing a conventional LAN solution. This special 'twist' forces the students to perform actual analysis and design to accommodate the special situation. All this is presented to the students as a Request for Proposal similar to those used in business and industry.

The faculty has noted that both non-traditional and traditional learners do well in this project. The solutions proposed by both groups of learners meet the performance criteria equally well. However, adult learners perform better in the report and presentation phases of the project. The faculty feels that this is most likely due to the life experiences these adult students bring to the project. Most have presentation and proposal experiences through their workplace. The adult learners also take a personal ownership in their project. This motivates them to elevate the quality of their proposals and presentations since they see this as a direct reflection on themselves.

The capstone project has allowed the measurement of comprehension, application, analysis, evaluation, and synthesis skills at a level that was impossible when conventional examinations were used. Based upon this alone, the faculty feels that the methodology has improved student preparation for the workplace. Students also seem to apply themselves more willing to a project than to a conventional exam evaluation mechanism. Further, skills mastered at the upper levels of Bloom's cognitive domain are retained longer.[7]

VI. Conclusion

Based on the success experienced in the data communications course, the faculty intends to apply the capstone project methodology to other courses. The faculty currently plans to implement capstone projects in sophomore applications programming and database courses. There are currently no plans to implement the capstone project methodology at the freshman level. At the sophomore level non-traditional learners have a slight advantage over traditional learners in the presentation and reporting aspects of the projects because of their life experiences. The faculty is concerned that non-traditional students will bring knowledge based on their life experiences to projects at the freshman level that will further distance them from the traditional

students. The traditional learners need the first year of their college education to offset this lack of life experience. The faculty feels that implementation of the capstone project methodology prior to the sophomore year will lessen its universal applicability with respect to andragogical and pedagogical learning situations.

While the faculty strongly feels that capstone projects represent a viable educational methodology for mixed traditional and non-traditional groups, they cannot currently present statistical data to support this. Regional campuses like Purdue's Anderson site have relatively small course enrollments. The data communications course cited here is offered only one semester each year and has a yearly enrollment of eight to twelve students. A class of this size tracked over the four-year period that the capstone project has been employed does not yield statistically significant data.

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