Learning by Design: Making the case for a Teaching Strategy to teach Information Systems Courses

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ABSTRACT
Teaching Information Systems in the undergraduate level requires certain skills to integrate theory with practice. One of the most effective teaching pedagogies is “Learning by Design” in which learners are fully engaged in the construction and the execution of the course activities. In the experience presented in this paper, “Learning by Design” helped students of Information Systems to understand very complex Decision Support Systems concepts. Students studied the typical academic advising process and developed a decision support tool for effective academic advising to support institutional planning and optimized resource allocation. Analysis of students’ performance and assessment evidence shows students understanding of course concepts. The successful transfer of knowledge from the theory base of the course to the completion of the final course project will make a case for the use of Learning by Design as a teaching tool in an Information Systems course.

Categories and Subject Descriptors
H.0 [Information Systems-General]: Effective Teaching Strategies for Information Systems Courses. K.3.0 [Computers and Education]: Information Systems Education.

General Terms
Human Factors.

Keywords

1. INTRODUCTION
The 21st century classroom has evolved from the instructor centered classroom with the restriction of four walls and the teacher solely relaying information to the learners. The traditional classroom is becoming a notion of the past. The learner is encouraged to take an active role in the learning process. Learners are engaged in their learning and assume responsibility for the building of knowledge. The introduction of this teaching and learning style does not change the fact that complex concepts are being relayed to the students for comprehension. The instructor or facilitator must guide the students in understanding these complex concepts in order to truly build knowledge that is applicable to real world problem solving.

There are many teaching strategies and educational methods that can be employed to aid the instructor in guiding students on the path of building meaningful knowledge. This paper posits the use of a teaching strategy that encourages the learner to understand complex concepts via the design and creation of solutions to real world Information Systems/Information Technology problems. The paper explores Seymour Papert’s Constructionism Theory; a theory that was conceived from Piaget Constructivist Theory [1], and finally suggests a learner-centered teaching method applicable to teaching the complex concepts in an information systems course. The theory of Constructionism suggests that learners will understand complex concepts by engaging in the design of an artifact, which will aid in the comprehension of the complex concept. Learning by Design was born from Constructionism, and it has been tested in both pre and post secondary education [2][3]. The authors will make a case for the use of Learning by Design as a teaching strategy for information systems courses.

1.1 An Overview of Constructionism Learning Theory
The instruction of information systems courses at the baccalaureate level involves teaching complex topics to students with little to no industry experience. The successful learning outcomes of these novice learners are seen through the application of these complex concepts to real world problems. Parker, LaRouge and Trimmer [4], Magnani and Montesi [5], call for the competent information systems professional that will bridge the gap between theory and practice in the field. The preparation of these graduates will be done by assisting learners in using the complex concepts learned to solve real world problems [6]. Learning theories that position the learner to engage in real world problem solving, would be most favorable for the IS students learning experience.

Papert [7] posits the idea that knowledge is constructed in the mind of the learner; these building blocks of knowledge are successfully created when learners are engaged in the construction of artifacts related to the complex concept taught in a course. The application of Constructionism in an IS course is encouraged because it is one of the learning theories that sees an important role in affect [7]. The Constructivist Learning Theory supports Constructionism [8]; the former suggests that knowledge is built by the learner and the latter further emphasizes the specific construction of external artifacts that are shared by learners. Although learners can construct and present knowledge or meanings without producing artifacts, the processes of construction are more evident when learners produce through reflection and interaction with other learners [9].

1.2 Learning by Design: Constructionism in the Information Systems Course
Constructionism encourages building knowledge blocks by creating external artifacts. The concept of Learning by Design is an extension of the Constructionism Theory. Learning by Design
Designing technology curriculum such as Information Systems curriculum following the “backward design” process is very advantageous for many reasons; we list two of these in the following.

1. In the traditional design, the assessments are created after the delivery of the lessons to evaluate the student learning, making assessment an activity after the fact in which the students are tested to report achievement levels; while in the backward design, assessment is a way of enduring learning specifically with complex concepts such as concepts taught in a Decision Support Systems course.

2. Technology courses usually involve practical and theoretical concepts that need to be taught for students to attain the course objectives. The balance between the amount of theory versus practical activities and tutorials is very important. However, faculty members usually plan the activities ahead of time (typically before the semester starts) leaving very little flexibility to tailor the activities to students’ needs at the time the course is delivered.

Using the “backward design” framework and the course objectives above as the goals for Stage 1, the course instructor designed the following “assessment evidence” as Stage 2 of the “backward design”.

Assessment Evidence 1 (Phase 1)
Students work in groups to research how DSS technologies are used in academic advising. This assessment aimed to set a theoretical background about the decision-making process, Decision Support Systems and models. The specification of the domain as academic advising aimed to synthesize a focus point in the research. At the end of this phase students were asked to present their research to the other groups during class meetings.

Assessment Evidence 2 (Phase 2)
Students interviewed academic personnel in the university to research the academic advising process and decision points in the process, and the models used. This assessment aimed to familiarize the students with a real-world decision making process and the use of Decision Support Systems and models in practice. Again students had to share their work with the other groups during class meetings.

Assessment Evidence 3 (Phase 3)
This assessment is the most important and motivating for the use of cognitive skills. Students had to implement a simple decision support model, tool, or system to support academic advising in their university. At the end of this phase each group of students had to prepare a report on the tool they created and peer-evaluate
2.2 Application of the Constructionist Learning Theory in an IS Course

The following points describe how the Constructionist Learning Theory was applied to the delivery of the course described in the case.

1. Presentation of rubrics which define expectations: In this Decision Support Systems project, expectations were defined with the students. Students received rubrics that acted as guides for embarking on the design of their projects.

2. Dialogue on interpretation of the assignment: Learners were allowed a session with the Instructor to relay questions about the assigned project. The students also had the opportunity to post questions related to the project on the course management system used at Effat University.

3. Learner Collaboration and Exploration of multiple strategies for tackling the assignment: Learners formed teams, as this aided the brainstorming process.

4. Presentation of work: Due to the academic calendar, students were given a deadline to complete the design of their projects. The students were asked to present their artifacts to the instructor and fellow students for discussion, review and assessment.

5. Learners working with professionals in the outside world: Students were not given this opportunity but it is encouraged in the students’ capstone project, that they involve the knowledge of an outside party as a technical advisor. In the experience of the researchers, this has created an environment for real world problem solving.

2.3 Research Methodology

The basic hypotheses for the design of the above described intervention are:

1. We can improve the student learning experience of complex Information Systems concepts using Learning by Design.

2. Students can be motivated by Learning by Design supported curriculum, to develop the assigned learning activities.

The current research constitutes basically of a simple case study. The research approach is based on the Learning by Design framework supported by instructional design using the backward design model. The research data collected include the analysis of students’ performance and assessment evidence.
the department in projecting the demand on each course and making decision on which courses should be offered each semester such that the resources are optimally allocated. The papers provided by the students were very detailed explaining the proposed tool. The following is a summary of the description of the first group proposed tool.

“The tool aims to semi-automate the decision-making process and solves decision problems for the academic department. It would enable to enter student information efficiently and easily. The tool gives summarized information to aid in offering courses every semester. It allows making calculations for decision-making, for example calculating the GPA, credits completed, remaining courses, number of pre-registered students for each course, etc. Designing an Excel-based DSS and combining it with VBA is the appropriate solution because Excel provides a great variety of functions for decision-making in a much easy-to-use way, for example, Excel charts can be inserted to display results. Information is currently saved mostly in Excel files, thus the proposed tool does not require much change or transfer of data”

The students developed the tool and attached screen prints of their work to their paper.

The second group of students implemented a spread-sheet based tool and a simulation model to be integrated with the student information system database. The tool is accompanied by an advising manual to educate the users and complement the tool functions. The group partially implemented and integrated the tool. The third group implemented a web-based application to solve the problem in similar fashion to the first group.

3.2 Analysis of Course Learning Outcomes

The analysis we conduct in this section looks at the set of intended learning outcomes achieved by each group. We use the scores that students achieved in the final project components as an indicator to assess the learning outcomes. The set of learning outcomes directly contribute to the course objectives indicated in Stage 1. The learning outcomes in the list below were discussed, finalized, and accepted by the students in the form of the final project rubric.

(a) Students learn to analyze a decision-making process and identify a problem (cognitive domain of learning);
(b) Students propose an appropriate solution for the problem (cognitive domain of learning);
(c) Students provide a detailed plan on the solution and implementation (cognitive domain of learning);
(d) Students learn about DSS types, technologies, models implemented (knowledge domain of learning);
(e) Student communicate their findings about DSS in a professional manner (communication and interpersonal domains of learning);

Table 1 below maps the assessment evidence described in the previous section to the learning outcomes above. The purpose of creating such mapping is to ensure that assessment evidence actually cover all learning outcomes as indicated in the table. Table 2 shows the scores achieved by the different students groups in the final project components.

The University and the Information Systems Department requires a minimum of 75% of learning outcome to be achieved in the average class. The scores in the table above indicate that the students have achieved high percentages of learning outcomes. Even in comparison to students average scores in other courses the results achieved in this intervention are considered impressive. Since the assessment design, implementation, and scoring are all done by the instructor, it is possible that the evaluation of the learning outcomes is not significantly precise, however, the comparison of the level of achievement occurred in this course (overall of 93%) was higher than the levels achieved in other courses taught by the same instructor.

4. CONCLUSION

The Information Systems field requires graduates that have a theoretical and technical grasp of concepts from database design, system analysis and administration, to decision support system design and support. It is important that educators take advantage of instructional strategies that encourage students to construct meaningful knowledge from the course material while being able to transfer this knowledge to the design of end products that solve real world problems.

The authors of this paper will continue to use Learning by Design as a teaching strategy for the information systems courses at their University. The authors hope to add to the literature on teaching strategies in the Information Systems field and encourage other educators to consider this teaching tool as an effective means of preparing competent graduates.
5. REFERENCES


