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THE RETURN ON INVESTMENT OF CONNECTED PROJECTS: A PAYROLL EXAMPLE

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Abstract

Projects requiring student investment can be leveraged by educators through additional assignments, providing a means for students to obtain "returns on their initial investment." This paper applies this concept with a payroll example. University students enrolled in an accounting information systems course invest in the initial project by creating a spreadsheet payroll system. Students then obtain returns on their investment through two additional projects: 1) analyzing their system using internal control and system development life cycle concepts, and 2) redesigning their system based on relational database concepts. Findings indicate students "return" their knowledge "investments" from the initial project into subsequent projects.

Many educators use some form of comprehensive end-of-term project as a tool for students to integrate their learning and as an assessment technique to measure the students' ability to integrate a diverse set of knowledge. Because of the desire to be complete and realistic, many of these projects can be quite complex. Given the right circumstances, a comprehensive project can be broken down into several smaller projects that yield integration of knowledge and can still be used to measure the students' abilities (both to integrate diverse knowledge, and stand-alone knowledge). This paper demonstrates how an initial project can be used to cause student "investment" in the core project and then shows how two additional related projects allow students to obtain returns on that investment.

The remainder of the paper is organized as follows: A review of the relevant literature is set forth and research questions are stated. Next, qualitative and quantitative evidence is provided to demonstrate investment-causing activities in Project 1. Qualitative and quantitative evidence is also provided to demonstrate return on these investments during subsequent connected Projects 2 and 3. Additional analyses are provided comparing Project 1 with Projects 2 and 3, and describing other returns on investment. Finally, conclusions, including limitations, are offered.

Literature Review

Accounting education has received numerous calls to change and update its curriculum. Van Wyhe (2007) provides an excellent synopsis of these calls. Some of the calls directed at accounting education include: the 1989 formation of the Accounting Education Change Commission, the 1994 creation of the Vision Project by the American Institute of Certified Public Accountants, and starting in 2002, attempts to dictate uniform educational requirements for the CPA exam by the National Association of State Boards.

Most of these calls for change focus on educators providing more coursework (e.g., the 150 credit-hour requirement and requiring ethics courses). However, the shortage of accounting Ph.D.s (Leslie, 2008) makes it difficult for universities to meet the growing demand for accountants. Compounding the situation is the fact that research and service demands on educators compete for time spent on teaching activities

(Beyer, Herrmann, Meek, and Rapley, 2010). Additional stresses on educators arise with the adoption of International Financial Reporting Standards (Munters and Reckers, 2010), along with the security, control, and technology issues that accompany this adoption (Moeller, 2010). Finally, educators have to work within the constraint of assessing a large number of students' performance based only on 45 contact hours.

Still, time constraints do not mean educators should shirk the duties and responsibilities of creating a pool of job-ready accountants. Instead, educators should work on sharing the burden of education with the constituent that arguably has the most to gain from the education experience--the student. These aspiring accountants obtain employment in a desirable and well compensated profession. In some ways students have taken responsibility for their education. For example, students are aware of skills beyond technical accounting knowledge such as business awareness, and the real world perspective necessary to be successful in the accounting profession (Kavanagh and Drennan, 2008).

Nevertheless, awareness alone may not be enough to transfer some of the educational burden to the student. A synthesis of instructional design literature implies that learning is promoted when students are engaged in such a way that they will both 1) exert effort to invest in knowledge, and 2) see the return of this initial knowledge investment through its subsequent use (Merrill, 2002). This concept of learning is depicted in Figure 1.

Figure 1

Research Model Derived from Literature Review

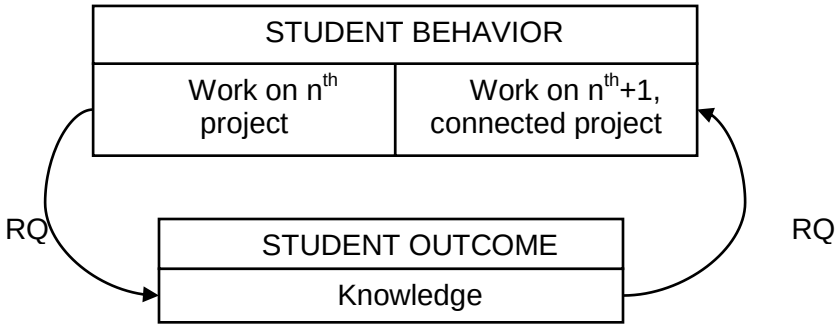

Figure 1 depicts a model in which a student engages in behavior to complete a learning event, specifically a project. This investment act causes the student to gain knowledge, which the student then uses (return on investment) to perform a subsequent learning event, or project. This study examines both 1) the willingness to apply effort to invest in knowledge during the initial learning event as well as the 2) use of acquired knowledge during subsequent learning events.

The first part of the model relates to the effort to invest in knowledge during an initial learning event. Specifically, investment refers to effort used to gain knowledge as a result of completing a learning event. Many research streams describe similar scenarios; for instance, experimental psychologists provide similar descriptions in motivation models where goals are achieved by behavior stemming from desires or vigilance. Dickinson and Balleine (2002) posit that behavior is motivated by the desire for specific commodities, resources, and state of affairs. Watts & Swanson (2002) demonstrate that motivated or goal-directed behaviors can be thought of at the simplest level as sets of striate muscle contractions that direct animals toward – or in some instances away from – a particular goal object. Although the concept of motivation is outside the scope of this research, these models are still relevant to the current study because as Mayer (2009) describes,

motivated, or involved, students exerted cognitive processing effort which is retained as a memory trace, in other words, knowledge.

Studies reported in the educational outcome literature use the concept of student involvement to describe how learning communities lead to favorable college experiences. Astin (1999) found that the amount of physical and psychological energy that students devote to the academic experience was indicative of a favorable college experience. Similarly, Zhao and Kuh (2004) linked engagement to student outcomes and overall satisfaction with college. Also, Lambert, Tant, and Watson (2008) described how student accountability differed in alternative learning situations. These studies are relevant in that they demonstrate students making investments in their education through involvement with various learning activities.

Learning activities can be viewed as knowledge-gaining processes used by students. Duff and McKinstry (2007) provide an overview of Student Approaches to Learning (SAL). SAL research has described several learning processes: deep learning, elaborative processing, agentic learning, methodical learning, and literal memorization (Giesler-Brenstein, Schmeck & Hetherington, 1996). Similarly, teaching and learning research describes cognitive, affective and meta-cognitive processes used in learning (Short & Weissberg-Benchell; 1989). These studies found that students employ a variety of these learning processes to gain knowledge and provide the mechanism for investment.

In summary, the research streams cited provide a holistic view of the efforts students use to complete projects in order to achieve knowledge gains. This is stated as the first research question:

RQ1: Will students create an investment of knowledge by completing a class project? (student investment)

The return on investments will be triggered through use of the knowledge in future activities. The integrative learning research (e.g., Newell, 1999; and Humphreys, 2005) describe various learning opportunities or tasks (e.g., residential learning, multicultural learning, interdisciplinary study, service learning, collaborative learning, cross-cultural learning, and learning communities) used to achieve the overall student objective of ordering, in their minds, the complex world. The incremental knowledge gained by each individual task is equivalent to investments described by the first research question. The further use of the incremental knowledge to update their ordering of the world is the essence of the concept of return on investment. Many educators provide students with small tasks throughout the term to build their knowledge base. At this point some educators leave it up to the student to integrate their learning (Sangster, Stoner, and McCarthy, 2007). Other educators use a comprehensive project (or exam) as a mechanism to facilitate integrative learning and student return on their learning investments (Van Merriënboer and Kester, 2007).

An alternative to the large scale end-of-term project is to employ an in-depth beginning-of-term project, coupled with several smaller, connected projects throughout the rest of the term. The intended benefit of using subsequent smaller projects is that students and educators can focus on specific task components. This should permit a closer matching of project learning objectives to textbook materials, allow students to focus on the specific knowledge previously gained, and allow examination and assessment of return on investments. For example, Rivet and Krajcik (2008) demonstrated the use of prior knowledge in learning science topics, and Hanson and Phillips (2006) demonstrated a similar effect using analogies in a university-level introductory accounting course. This conception of return on investment of learning can be summarized as the second research question:

RQ2: Can returns on investment of a student's knowledge base be gained through subsequent, connected projects? (student return on investment)

Project 1 - Payroll System Building Demonstrating Student Investment

In this study three projects were assigned to accounting majors, enrolled in an accounting information systems class, over the course of a semester. Generally, these accounting majors are required to complete a number of premajor courses (such as introductory accounting and business

courses). Although some students may have taken several accounting major courses, in general, payroll systems are not a topic covered in upper division accounting courses. Grades for the projects were based upon completeness and correctness of the project, as well as written reflections related to the experience of completing each project. These three projects totaled 40 percent of the overall grade of the course.

The projects were based upon a payroll system. Each project required various deliverables including a written description of the student experience with the project. In Project 1, students created a spreadsheet-based payroll system based upon 60+ payroll records. Students were given three weeks to complete the project. Class time was used to describe system, spreadsheet, and payroll concepts, as well as to provide students with hands-on system building experience. During this three-week period student investment was expected to occur in three areas: 1) system building, 2) knowledge of system strengths and weaknesses, and 3) knowledge of spreadsheet capabilities.

These investments are observed qualitatively based upon student writing excerpts:

System building: "the payroll spreadsheet was a much more efficient way of preparing payroll than manually doing the payroll as I had done previously. After the initial set-up of the formulas, the spreadsheet really does all of the calculating work for you."

Knowledge of system weaknesses: "While I know that my payroll system was not perfect, it did provide a basis for further investigation and learning."

Knowledge of system strengths: "create a reliable spreadsheet that is beneficial to the end user ... By using formulas, it reduces man hours spent entering information... many forms can be completed by retrieving information from one central spreadsheet."

Knowledge of spreadsheet capabilities: "even though the main purpose of this assignment was not to learn how to use Excel better, I did end up learning how to use it more effectively to my advantage."

In order to triangulate the qualitative evidence, three survey instruments were designed and administered after students completed each of the three projects. Questions in the surveys focused on perceptions related to performance of multiple projects versus a single comprehensive project. A five-point Likert scale was used to determine student perceptions of areas in which they invested in the initial project as well as areas receiving a return on this investment. The scale consisted of end points of "strongly agree" (5) and "strongly disagree" (1) with the term "neutral" as the center point (3). The survey categories mirror the categories identified by prior student responses. Results of student responses to the survey (n = 35) administered after the first project are depicted in Table 1.

Table 1

Results of Project Investment Survey (n=35‡).

Question	Mean	Sig*	%>3†
IN RELATION TO OTHER UPPER DIVISION CLASS PROJECTS:			
The payroll project was more encompassing	4.09	0.00	91
The payroll project was more complex	4.12	0.00	91
The payroll project was more realistic	3.93	0.00	74
I put more effort into this payroll project	4.18	0.00	89
I developed my spreadsheet skills more from this payroll project	4.20	0.00	89

AFTER PERFORMING THIS ASSIGNMENT I HAVE A BETTER UNDERSTANDING OF:			
System building	3.93	0.00	80
System strengths identification	3.76	0.00	77
System weakness identification	3.84	0.00	83
Spreadsheet capabilities	4.16	0.00	94
Internal controls	3.53	0.00	57

* one-sample, two-tailed t-test comparing mean to neutral score of 3.
† 3 indicated a neutral response on our 5-point Likert scale.
‡ Based upon class attendance during administration of survey instrument.

Not surprisingly student responses were all significant. Furthermore, a large percentage responded above neutral. Although the payroll project was not intended to be more comprehensive and complex than projects students normally receive, these students were in their senior year and needed to perform more comprehensive and complex projects similar to that found in the workplace. It is encouraging to note: 1) Students felt the project was realistic, 2) Spreadsheet skills were developed, 3) Students put effort into the project, and 4) Students gained knowledge in areas related to the payroll project.

Project 2 - Return on Investment through Internal Control Analysis and Redesign

The second project consisted of students' internal control evaluation of their systems and subsequent use of system development life cycle (SDLC) concepts to aid in redesigning the controls. Specifically, students were required to identify two "strong" and two "weak" internal controls related to the payroll system built during the initial project. For the weak internal controls, students were asked to follow a portion of the SDLC to identify activities that could strengthen the "weak" controls. Students were given two weeks to complete this task. Class time was used to discuss internal control concepts, SDLC concepts, and explore and draft potential analyses.

Return on student investments should manifest itself as a general "case" familiarity. Specific returns on student investment of internal control strengths and weaknesses assessment should materialize at this stage as focus on current project task. Finally, returns on system building should be demonstrated through the relevance of prior project feedback, and motivation to improve on prior projects. Some examples of these returns are found in the following student quotations:

Familiarity with "case": "By working with a project that we created in class, we are able to see the problems in our systems and then develop plans to correct those problems."

Focus on current project task: "It allowed us to experience the Enterprise Risk Management framework… Also…actually working with it [System Development Life Cycle] for this project solidified the life cycle in my mind which I think was a very helpful way of learning it."

Relevance of prior project feedback: "it is also the first time I have gone back and looked at what is right and wrong about the information system. This really opened my eyes to see how much can be done to improve a system."

Motivation to improve on prior project: "Hopefully a small business will be able to use my payroll program in the future after I go back and add more detail to it."

Upon completion of Project 2, students were requested to complete surveys related to the project. Results of student responses related to the task issues (n = 36) are depicted in Table 2.

Table 2

Results of Project 2 Return on Investment Survey (n=36‡).

Question	Mean	Sig*	%>3†
IN RELATION TO OTHER UPPER DIVISION CLASS PROJECTS:			
The IC/SDLC project was more encompassing	3.11	0.40	36
The IC/SDLC project was more complex	2.89	0.35	19
The IC/SDLC project was more realistic	3.61	0.00	72
I put more effort into this IC/SDLC project	3.17	0.31	33
AFTER PERFORMING THIS ASSIGNMENT I HAVE A BETTER UNDERSTANDING OF:			
System building	3.83	0.00	78
System strengths identification	4.00	0.00	89
System weakness identification	4.08	0.00	94
Spreadsheet capabilities	2.92	0.65	36
Internal controls	4.11	0.00	89

* one-sample, two-tailed t-test comparing mean to neutral score of 3.
† 3 indicated a neutral response on our 5-point Likert scale.
‡ Based upon class attendance during administration of survey instrument.

As shown in Table 2, comprehensiveness, complexity and effort are no longer significant. This indicates that the second assignment is not different from those normally prepared by students. The results reported in Table 2 show that students consider the assignment realistic and appear to have gained knowledge of system building and internal control strengths and weaknesses by completing this assignment, not from the spreadsheet (which was not a project objective).

A set of additional questions specifically addressing the connection of the second project with the first project was also given to students. Responses to these questions (Table 3) were all significant, and each item's percentage greater than neutral (%>3), on a Likert Scale, was large. These results indicate that student investment in the first project resulted in returns.

Table 3

Results of Project Connection Survey (n=36‡).

Question	Mean	Sig*	%>3†
BECAUSE OF THE CONNECTION TO THE PAYROLL PROJECT:			
The IC/SDLC project made more sense	4.14	0.00	86
The IC/SDLC project was simpler	3.61	0.00	58
The IC/SDLC project required less time	3.33	0.04	44
I used feedback to prepare the IC/SDLC project	3.83	0.00	75

*one-sample, two-tailed t-test comparing mean to neutral score of 3.
† 3 indicated a neutral response on our 5-point Likert scale.
‡ Based upon class attendance during administration of survey instrument.

Third Project - Return on Investment through Database Upgrade

The third related project consisted of students upgrading their spreadsheet-based payroll system to a database system. Specifically, students were required to build a database that could house their payroll data, import (cut & paste) their data from their spreadsheet-based payroll system, and make certain queries of the database. The students were given two weeks to complete this project. Class time was used to discuss database concepts such as flat files, relational database systems, and query by example (QBE) interfaces and structured query language (SQL). Class time was also used by students to perform hands on work with Microsoft Access and a SQL interface.

Return on student investment was expected to be observed through "data" familiarity. Specific return on student investment of system building would be demonstrated through a focus on database structures and relationships. Furthermore, spreadsheet concepts would be reinforced through the comparison of database systems with spreadsheet systems. The following student quotations exemplify these returns:

Data familiarity: "This project required fewer assumptions than projects in the past. This is because many of the assumptions were already made in the first payroll project database. These assumptions were assumed to be correct and the data was simply taken from that database."

Focus on database structure and relationships: "This database assignment was both easier and harder for me than the previous assignments. It was easier because I did not have to perform any calculations or think about financial or managerial accounting statements. It was more difficult, though, because I had never worked with a database system before and had to learn the details of the system."

Comparison with spreadsheet system: "The database was much easier to query and extract data than a program such as Excel. …This was visible even with the small amount of data that we were working with. It is very easy to see, then, that databases would be an enormous help to large companies with more data."

After completion of Project 3, students were requested to complete surveys related to the project. Results of student responses related to the task issues (n = 34) are depicted in Table 4.

Table 4

Results of Project 3 Return on Investment Survey (n=34‡).

Note: 3 indicated a neutral response on our 5-point Likert scale.

Question	Mean	Sig*	% > 3†
IN RELATION TO OTHER UPPER DIVISION CLASS PROJECTS:			
The database project was more encompassing	3.49	0.00	62
The database project was more complex	3.63	0.00	68
The database project was more realistic	3.79	0.00	62
I put more effort into this database project	3.47	0.01	56
AFTER PERFORMING THIS ASSIGNMENT I HAVE A BETTER UNDERSTANDING OF:			
Database concepts	4.24	0.00	94
Database capabilities	4.24	0.00	94
Spreadsheet capabilities	3.61	0.00	65

* one-sample, two-tailed t-test comparing mean to neutral score of 3.
† 3 indicated a neutral response on our 5-point Likert scale.
‡ Based upon class attendance during administration of survey instrument.

As shown in Table 4, comprehensiveness, complexity and effort are now significant, indicating that the third assignment is different from those normally prepared by students. The results reported in Table 4 also indicate that students considered the assignment realistic and appear to have gained database concepts and capabilities knowledge from completing this assignment.

Similar to Project 2, students were asked additional questions related to connecting Project 3 to prior projects (Table 5). The responses were all significant, and each item exhibited large percentages greater than neutral (>3) on a Likert scale. Similar to the results in the Project 2 connection survey, these results indicate that student investment in the first project resulted in returns.

Table 5

Results of Project Connection Survey (n=34‡).

Question	Mean	Sig*	% > 3†
BECAUSE OF THE CONNECTION TO THE PAYROLL PROJECT:			
The database project made more sense	3.76	0.00	73
The database project was simpler	3.51	0.00	62
The database project required less time	3.45	0.01	62
I used feedback to prepare the database project	3.37	0.01	50

* one-sample, two-tailed t-test comparing mean to neutral score of 3.
† 3 indicated a neutral response on our 5-point Likert scale.
‡ Based upon class attendance during administration of survey instrument.

Comparison across Projects

The research protocol also allowed for paired comparison of survey questions, which provide some insight to the relationship between the project as well as the achievement of the learning objectives. The results of comparing projects 1 and 2 are shown in Table 6. In terms of overall project attributes, comprehensiveness, complexity, and effort are significant. This provides evidence that future, connected projects do not need to be as comprehensive as the initial project for learning to occur. Realism is not significantly different between projects.

Table 6

Pair t-test Between Projects 1 and 2 (n=25‡).

Question	P/R Project 1	I/C Project 2	Sig*
IN RELATION TO OTHER UPPER DIVISION CLASS PROJECTS:			
The project was more encompassing	4.03	3.12	0.00
The project was more complex	4.09	2.88	0.00
The project was more realistic	3.85	3.52	0.14
I put more effort into this	4.20	2.96	0.00
AFTER PERFORMING THIS ASSIGNMENT I HAVE A BETTER UNDERSTANDING OF:			
System building	4.01	3.92	0.44
System strengths identification	3.77	3.92	0.46
System weakness identification	3.85	4.08	0.10
Spreadsheet capabilities	4.27	2.76	0.00
Internal controls	3.50	4.16	0.00

* matched-paired, two-tailed t-test.

‡ Lower N due to inability to match several responses from project 1 and project 2.

In terms of specific learning objectives, the data indicate that knowledge gained from system building, strength and weakness identification are not different. This may be due to coarseness of the survey questions (e.g. system building theory versus practice). Differences in knowledge gained from spreadsheets and internal controls are consistent with the objectives difference between projects 1 and 2.

The results of comparing projects 1 and 3 are shown in Table 7. Analysis of the overall project attributes indicates that comprehensiveness, complexity, and effort are significant, again offering evidence that subsequently connected projects do not need to be as comprehensive as the initial project for learning to occur. Again, realism is not significantly different.

Table 7

Pair t-test Between Projects 1 and 3 (n=27).

Question	P/R Project 1	DB Project 3	Sig*
IN RELATION TO OTHER UPPER DIVISION CLASS PROJECTS:			
The project was more encompassing	4.11	3.47	0.00
The project was more complex	4.16	3.64	0.02
The project was more realistic	3.92	3.79	0.59
I put more effort into this	4.19	3.54	0.00
AFTER PERFORMING THIS ASSIGNMENT I HAVE A BETTER UNDERSTANDING OF:			
Database concepts	3.54	4.33	0.00
Database capabilities	3.62	4.33	0.00
Spreadsheet capabilities	4.21	3.69	0.01

* matched-paired, two-tailed t-test.
‡ Lower N due to inability to match several responses from project 1 and project 3.

In terms of specific learning objectives, the database project (Project 3) offered greater learning of database concepts while the payroll project (Project 1) offered greater learning of spreadsheet concepts. These results are not surprising and are congruent with the different project objectives.

Other Returns on Investment

The students' responses contained other examples of returns on investment that are not specifically addressed by this paper. These include textbooks, other classes, self-directed learning, and work experiences. The following excerpts are additional examples of return on investments:

Textbook: "It fully incorporates the information that was presented in the textbook and gives a real world example of how the process [SDLC] can be used."

Other classes: "Other [accounting] classes often have discussions about the proper recording processes when dealing with payroll… it coincides with discussions relating operations management as well as finance."

Self-directed learning: "The computations of … taxes proved to be a bit of a challenge for me, but it also caused me to do some research on the IRS website which I probably would not have done otherwise."

Work experiences: "I naively took for granted the work that goes into creating a payroll system. The payroll system that I have had experience with was only for two people, and the tax calculations were done manually with tax tables. I was unaware of the many complexities that can go into the computerized system."

Conclusion

This paper examined student investment in an initial project as well as returns on those investments through subsequent projects. A definition of student investment and return on investment was proposed. An initial project was used to demonstrate student investment in knowledge. Students were then assigned two additional projects in order to demonstrate returns on the investment in the initial project. Both the qualitative and quantitative results presented in this paper suggest that student investment in the initial project provided returns on the investment with future projects. Specifically, an investment with an initial system spreadsheet-based project brought

returns to an internal control and SDLC project, as well as a database migration project.

Individually, limitations of qualitative student responses and quantitative survey results exist. However, the qualitative responses provide richness that is lacking in any statistical analyses. Limitations to qualitative analysis may include misinterpreted excerpts, and questions could be raised related to excerpt selection. Survey responses provide an objective vehicle with statistical support providing validity of the research but also have limitations. Survey questions could be misinterpreted by students, and students may desire to respond positively to the survey. The use of both methods in this study was intended to address the weakness of individually applying either qualitative or quantitative methods. In this case arguments could arise on the ability to provide a congruent coupling of the qualitative and quantitative methods.

Although student responses indicate that returns on investment occur, it is unclear if similar returns could have been obtained using a single comprehensive project. While multiple projects allow the educator to provide feedback and guidance for future projects, a single project (if returned to the student) could provide the same benefit. The effectiveness of multiple projects versus a single comprehensive project cannot be examined with the current data set, but future research projects could be designed to investigate this area. Furthermore, as suggested by students, return on investment occurred from other sources such as textbook reading, prior classes and work experience. Again, future research projects might examine different sources of the returns.

Regardless, the research described in this paper shows that a comprehensive project broken down into several smaller projects can result in knowledge integration and can be used to measure the students' abilities (both to integrate diverse knowledge, and stand-alone knowledge). This paper demonstrated that an initial project can be used to cause student "investment" in the core project, and then shows how two related projects allow students to obtain returns on that investment. Use of the techniques described here may aid educators and students in improving the efficient use of increasingly constrained resources.

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