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Using Deming's Cycle for Improvement in a Course: A Case Study

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ABSTRACT

The boundaries between accounting and technology is becoming fuzzier as accounting companies are becoming consulting companies. Digital economies are changing business models and companies that do not adept can become obsolete very fast. Even professional organizations are recommending using technology to modernize, automate and expedite accounting discipline. Therefore, it is necessary to train personnel to become competent in both technology and accounting. Universities are fulfilling this requirement by offering courses such as Accounting Information Systems, data analytics, big data, etc. This article uses Deming's PlanDoCheckAct (PDCA) cycle for longitudinal assessment and improvement of the AIS course. Instead of re-inventing the wheel, instructors can learn from our experience. This article would be useful for instructors trying different and emerging approaches. In addition, this article would be useful for instructors trying to engage students and to train them for future challenges.

KEYWORDS

Accounting Information Systems, Case Study, Longitudinal Assessment, PDCA Cycle

INTRODUCTION

As technology diffuses across organizations, functional boundaries are becoming blurred. Accounting firm, Deloitte Touche Tohmatsu Limited (DTTL), advertises themselves as offering technology services, "Today business and technology are inextricably linked… keeping pace with the emerging technology landscape can be difficult for even the most tech-savvy leaders." Businesses are recognizing the evolving nature of fast paced technologies that is changing client requirements. Clients are asking for a complete seamless solution to their problems. It is not only tax, audit or balance sheets, but it is "off-the-shelf" total package they are demanding. Big accounting companies are transforming as Accounting Information Systems Services (AISS) companies by providing not only tax and audit consultation, but also IT related advice to their clients. According to a Pathway Commission Report on Accounting Education, (2012):

…businesses are processes, not buckets of accounting information. If the accounting community continues to concentrate on the financial accounting system and not understanding the technology

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and dynamic business processes that run companies of the 21st century, the accounting profession has the potential to become obsolete. While this may be a bit strong, the point was made loud and clear: Our students and faculty need to adapt to the speed of change of technology and business practices.

Advances in technology demand complete and seamless training that goes across functional areas. As companies provide whole solutions, it becomes more important not only to comply with regulations like the SOX, HIPPA, etc., but to accomplish them efficiently and in the shortest time possible. Technology is there to assist in this endeavor. Universities are fulfilling this knowledge gap by offering courses such as Accounting Information System AIS), Data Analytics in Accounting etc.). Universities must train students to better understand the data, processes and technology that can generate desired reports and insights to satisfy or validate compliance. AIS is a moving target since technology is changing rapidly. It is important not only develop an AIS course but also to improve it continually. This paper addresses one such course, namely AIS, and studies its continuous improvement using PDCA cycle proposed by Deming. This study should be beneficial to faculty planning to engage students and continually improve the AIS courses. Instead of reinventing the wheel, this study provides an excellent starting point for continuous improvement and the assessment process.

Next section discusses current literature, followed by the experiment.

LITERATURE REVIEW

AIS is becoming a critical part of all businesses. Özdoğan (2017) noted that technology-based accounting start-ups with both accounting professionals and entrepreneurs having an expertise on information technologies will come together and will increase in the future, and cloud-based accounting initiatives will shape the future of the profession. Adler et al. (2016) noted that it is important to train student in real-world understandings of accounting. Describing the current research in accounting, Sangster (2015) noted "accounting faculty publish top-quality research on accounting regulation, financial markets, business finance, auditing, international accounting, management accounting, taxation, accounting in society, and more, but not on what they do in their 'day job' – teaching accounting." Borthick et al. (2017) also showed importance of data analysis in decision making. Several others like the DTT report (2015), PWC report (2015) have also stressed the importance of technology and accounting. Following Sangster, Adler and Borthick this paper focuses on an evolving accounting course - accounting information systems. AIS is one area that is fusing different disciplines like accounting, information systems, law, database and data analytics to name a few and universities are preparing students for these emerging challenges. Though PDCA was primarily used in manufacturing, several authors recently have used it to improve their course, programs and skills. Sharif et al. (2000) used PDCA cycle to study Accounting information system program and revised their programs based on several iterations. Their efforts were, however, were directed on developing an AIS program rather than improving an AIS course. Knight et al. (2012) employed Deming's PDCA Cycle of continuous improvement as a systematic procedure to assess Public Relations Writing. After several cycles they concluded public relations writing is a fundamental skill for students' success and pedagogy that teaches students to write news releases. Taniguchi et al. (2018) studied a Project Management Information Systems (PMIS) course using PDCA cycle. Authors concluded, "the continuous improvement on the reporting quality of PMIS was found to be effective in achieving quality of PMIS output information to help managers in decision making, planning, organizing and controlling the project. It was also effective in positively influencing project management success in terms of the following three project management dimensions: Doing the project at the acceptable time; Observing the budget (cost) and Meeting the quality specifications of the project." Though above studies used PDCA approach but were not directly related to an AIS course. In this study, results from direct measurements are used to evaluate and improve the course. Specifically, three semester results are compared for student performance. While the results show

improvement, the course requires continuous improvement to meet current challenges. In addition, we briefly look at the future direction of an AIS course and how it is integrated with business intelligence and computer science disciplines.

The next section describes the AIS course and the later sections that follow describe the study.

Accounting Information System (AIS)

AIS is defined as a course that:

combines the study and practice of accounting with the design, implementation, and monitoring of information systems. Such systems use modern information technology resources together with traditional accounting controls and methods to provide users the financial information necessary to manage their organizations. (Henson, 2009)

Other authors (Romney & Steinbart, 2015; Gelinas & Dull, 2015) have also provided similar explanations. Given these definitions, the AIS course has the following learning objectives:

- Identify the primary methods of collecting and processing data about an organization;
- Illustrate the use of a database management system;
- Identify and illustrate system development and documentation techniques;
- Explain computer-based information systems control;
- Understand and illustrate the use of accounting forensics in a fraud situation;
- Identify system development and system analysis techniques;
- Understand the XBRL importance and evolving technologies.

As evidenced by the course objective, AIS includes information systems with accounting applications. This course is an **a**typical accounting course since outcomes may be approximate (or many) rather than absolute. The next section describes the methodology and the hypothesis.

METHODOLOGY AND HYPOTHESIS

We use Deming's P(plan)D(do)C(heck)A(act) cycle that has been used extensively in manufacturing for quality control (Deming, 1986; Juran, 1989) and continuous improvement. Lately PDCA has also been used in education research for continuous improvement and quality assessment (Taniguchi et al, 2018; Knight et al, 2012; Aggarwal et al, 2006).

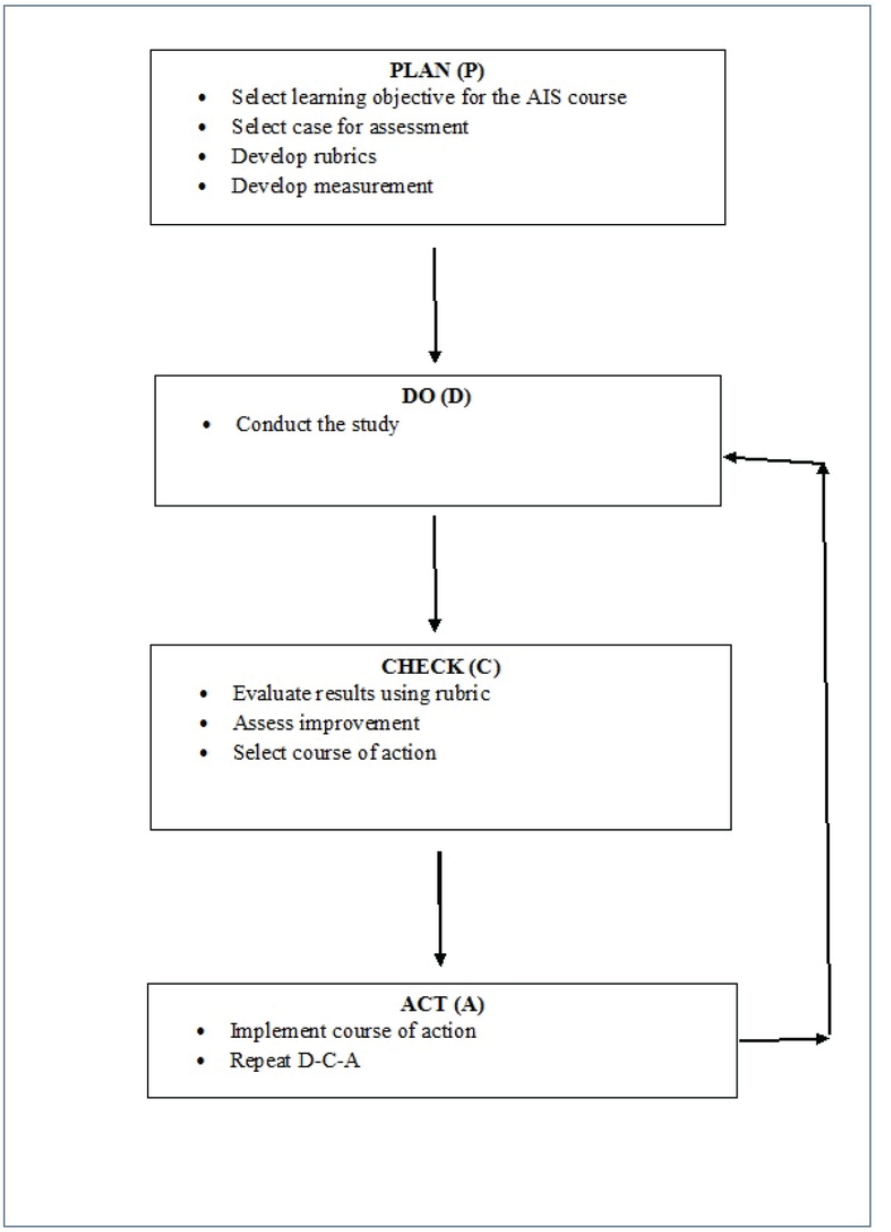
This cycle typically involves:

PLAN: Planning the study (select learning objectives)
DO: Conducting the study, (develop the study)
CHECK: Checking the results and identifying weaknesses, identify treatment
ACT: Implement the treatment

Once a plan is made and study is developed, weaknesses, if any, are identified (check), then treatments are identified (act) to mitigate or eliminate those weaknesses. Figure 1 shows the mapping of the AIS course into PDCA cycle. PDCA cycle is continuous, however only one cycle is shown for illustration purposes.

Planning involves selection of a learning objective that researchers want to study. The current AIS course has several LO and we selected the "explain computer-based information system controls" as the learning objective for this study. A case assignment was used to study student performance, with students having the following tasks:

Figure 1. Mapping of AIS course into PDCA cycle



1. Identify at least four events or threats that may confront this start up;
2. Estimate the likelihood of each threat happening. You may have to go to the Internet for this part. (If not found, use subjective assessment);
3. Estimate the impact (may be subjective assessment);
4. Identify controls to guard against each threat identified in 1;
5. Estimate cost/benefit analysis;
6. Suggest a course of action (reduce, avoid, share or accept);
7. Identify any ethical and control issues with the case.

The above requirements were mapped in Bloom's taxonomy as comprehension, analysis and application competencies (see Table 1). This mapping "Comprehensive, Analysis and Application" reinforces several aspects of overall learning objectives of the accounting program.

Table 1. Information system controls in terms of Bloom's Taxonomy

Comprehension	• Analyze the case situation
Analysis	• Identify components o threats o controls
Application	• Develop o Cost/benefit analysis • Apply o Course of action (control) o Ethical Issues

Develop Rubrics

Rubrics are typically used to assess performance. Many authors have recommended using rubrics to measure learning objectives in various disciplines (de Klerk et al, 2016; Brooks, 2013; Shepherd & Mullane, 2011; Ravenscraft et al, 2005). For example, Schafer et al. (2016) used rubric to assess student achievement of three learning goals: accounting measurement, research, and critical thinking. Cascini et al. (2007) used rubric to assess problem solving skills of accounting students. According to several researchers and organizations (Stegeman, et al, 2016; Andrade, 2010; rubistar, 2008), a rubric specifies the level of performance expected for several levels of quality. A rubric requires identifying level of ratings and quality indicators. We used rubric as a way of measuring student's system control application skills. First step was to select quality indicators. Once quality indicators were developed, a measurement criterion was developed and for simplicity's sake it was decided to use the same scale as the ones used in the class room, i.e., A, B, C and F. Note D and F were combined as F since D is not a passing grade. An actual rubric for problem solving competency was developed using rubistar's model. Rubric for system controls relates to Bloom's taxonomy of system controls (see Appendix).

An assessment approach was developed to identify A, B, C and F. Following criterion was used:

"A" was given if the student was able to comprehend, analyze and apply the concepts correctly on one hand and an "F" was given if the student did not do any of the part correctly.
Since the first two parts (plan and do of the PDCA cycle) are defined to some extent, we will concentrate on the last two parts: check and act.

Check:

- Assessing results
- Identifying weaknesses

Act:

- Diminish the weaknesses
- Repeat the steps until desired results are met

The study involves three semesters (three semesters):

Semester 1: Initial assessment (semester 1)/check and act.
Semester 2: Compare the first two semesters/check and act.
Semester 3: Compare the last two semesters/check and act.

Once results are checked and treatment used, it is expected with the treatment that students would perform better in the next semester (semester). Hence, the following hypothesis was developed:

H1: Students in second semester perform better than the first semester.
H2: Students in the third semester perform better than the second semester.

Student learning was measured by their score in the control assignment and a difference in means test was used to test this hypothesis. The next section describes the case.

The Case Study

The study involves an undergraduate class in an AIS course that is required of all accounting majors at a mid-Atlantic university. Study was conducted in hybrid and web-based classes. Hybrid classes used web extensively for both textual and software knowledge. A typical class has 12 to 50 students depending on the semester and delivery mode. The course has many information-related components and software competencies are needed to successfully complete this course. There were 63 students in semester 1, 53 students in semester 2 and 28 students in semester 3. The typical student in these classes is either a freshman or sophomore and does not have a formal background in information systems. Student population has not changed over time in terms of functional or surface level diversity removing age, gender, race or functional expertise impact on the treatment and its outcome.

Several authors (Xu et al., 2015; Smith et al., 2016; Mancini et al., 2016) have identified important factors like technology and control for a successful AIS. The AIS course consisted of the following three assignments:

- Database
- QuickBooks
- Controls

An assignment on controls was used for this study. This assignment was selected due to competency requirements both in accounting and in technology. A brief description of assignment is included here.

The assignment involved a startup food delivery business created by three students, “Three college friends, Johnny, Mesi, and Ford are planning to start a joint venture Food_r_us. Each of them is willing to put $50,000 for this new venture. There are many risks in such a startup and they realize if the business fails they could lose it all. Probability of this happening is 20%.” They were provided details of operations and hiring issues, such as, “They will run the business from Johnny’s basement to minimize facility costs. Food_r_us, however, needs to fill two major positions, a web master and an accountant. Ms. Lee, a friend of Ms. Mesi is a possible webmaster candidate and Mr. Petty, younger brother of Johnny is a possible accountant candidate. Ms. Lee is working as a webmaster for eBay has a computer science degree and Mr. Petty is working as a salesman at a local car dealer and has high school diploma. If Ms. Lee is hired, she would have to resign from eBay. The following deliverables were required:

Part A

1. Identify at least four events or threats that may confront this start up;
2. Estimate the likelihood of each threat happening. You may have to go to the internet for this part. If cannot find it justify and use subjective assessment);
3. Estimate the impact (maybe subjective assessment);
4. Identify controls to guard against each threat identified in part 1;
5. Estimate cost/benefit analysis (may have to estimate some costs and benefits; use internet);
6. Suggest a course of action (reduce, avoid, share or accept).

Part B

Discuss any ethical and internal control issues that may arise with the hiring of Ms. Lee and Mr. Petty. If Ms. Lee and Mr. Petty are hired they will leave their current jobs.

The following section discusses the results.

ANALYSIS AND RESULTS

Once the study was conducted results were analyzed. Study itself was conducted over three semesters and each semester (stage) is described below. All statistical analysis was performed in SPSS.

Semester 1

Check/Act

We looked at the grade distribution for the control assignment for the first semester. Table 2 shows the results. We used the following scale for grades: 90+ for A; 80+ for B, 70+ for C and <70 for F.

Table 2. Class performance: Semester 1

Grade	Frequency	Cumulative Percent
A	17	27%
B	18	28%
C	10	17%
F	18	28%

It is clear from Table 2 that students did not perform well, as almost 45% got C or less and almost 28% failed the assignment. The most disturbing result was that almost 20% did not attempt or performed poorly in the assignment. This required further examination.

Assignment had four deliverables (threat, control, cost/benefit and ethical issues). The analysis revealed students were having trouble identifying the threats since this was an open-ended assignment. Students were not clear about the case and its requirements. However, those who identified threats were able to recognize the appropriate controls. Students had problems with cost/benefit analysis and ethical concerns. Student comments suggested they would like better assignment explanation and more hands-on exercises. Some students mentioned ambiguity of the assignment. For example:

I would like him to explain assignment better.

Another student mentioned:

He should show students how it is done (project).
I would include more graded assignments.

Based on student input, it was decided to use additional in-class exercises for control and ethical issues. We followed Wilkin's (2014) approach to use cases to enhance learning. Several in-class exercise from the textbooks were used to identify threats, appropriate controls and possible ethical issues. A video clip of the movie Erin Brockovich was used to discuss general business ethics. In addition, we clarified the language of the case, but still kept it as an open-ended assignment. Next, we study the impact of these actions (treatment).

Semester 2

We looked at the differences in performance from semester 1 to semester 2. SPSS was used to analyze the results for difference in the means. Tables 3(a) and 3(b) summarize the results.

Table 3a. Group statistics

	Semesters	N	Mean	Std. Deviation
Assgn3	2	53	19.7830	6.06575
	1	63	15.8095	9.50527

Tables 3(a) and 3(b) reveal that treatment did improve performance by 25% from semester 1 to semester 2. We see strong support for our hypothesis H1 at $\alpha = .05$ level, implying that the treatment made a significant difference in student performance on this assignment. However, about 18% of

Table 3b. Independent samples test

		t-Test for Equality of Means		
		t	df	Sig. (2-Tailed)
Assgn3	Equal variances assumed	2.626	114	.010
	Equal variances not assumed	2.724	106.733	.008

the students still received a C grade or below. Because it is a passing grade, a "C" was considered satisfactory from most perspectives, but we wanted to improve it further and determine if we could eliminate failures. Students in both groups were similar with respect to gender, race and other surface level characteristics.

Check/Act

Semester 2 analysis revealed that most students were able to identify threats and appropriate controls, but were still having problems identifying ethical issues and estimating cost/benefits of each control. To reduce the impact of the repeated use of a case, original case was modified with a different scenario but similar requirements. This time, however, we adopted a roleplaying approach. Jordi et al. (2016) have suggested using digital games to improve student performance. In addition, Riley

et al. (2017) reported active learning enhances student's performance in an accounting information systems course. Students were asked to play parts related to a case on digital media (like CSI on digital device) and identify threats, controls and ethical issues emerging from those threats. Groups were formed and each group selected their case from TV. Each student played a role based on the episode selected. Students were encouraged to map selected episode steps to the issues related to the case. The role playing has dual purpose, to identify ethical issues related to accounting forensics and steps in accounting forensics itself. This resulted in better student engagement since student could relate case to topics of their interest. In addition, students were encouraged to use "IDEA," an accounting database software for any additional analysis. It was assumed since students were already trained in ACCESS, a database software, IDEA software implementation would be easy. However, we found that was not the case. Software skill portability was not observed, as students needed extra instructions on IDEA software. Once instructions were provided students were able to use it.

Semester 3

We looked at the differences in performance from semester 2 to semester 3. SPSS was used to analyze the results for difference in the means. Tables 4(a) and 4(b) summarize the results.

Table 4a. Group statistics

	Semester	N	Mean	Std. Deviation
ass3grade	3	28	23.286	3.0654
	2	53	19.783	6.0658

Table 4b. Independent samples test

		t-Test for Equality of Means		
		t	df	Sig. (2-Tailed)
ass3grade	Equal variances assumed	2.863	79	.005
	Equal variances not assumed	3.452	78.911	.001

Check/Act

Tables 4(a) reveals that treatment did improve average (mean) performance by 17.7% from semester 2 to semester 3. Also, all students received C or better in the assignment. Table 4(b) provides strong support for hypothesis H2. This is just beginning of assessment loop since technology is dynamic and therefore, the course assessment should also be dynamic. The next section looks at the results and provides suggestions for future course enhancements.

Post Analysis

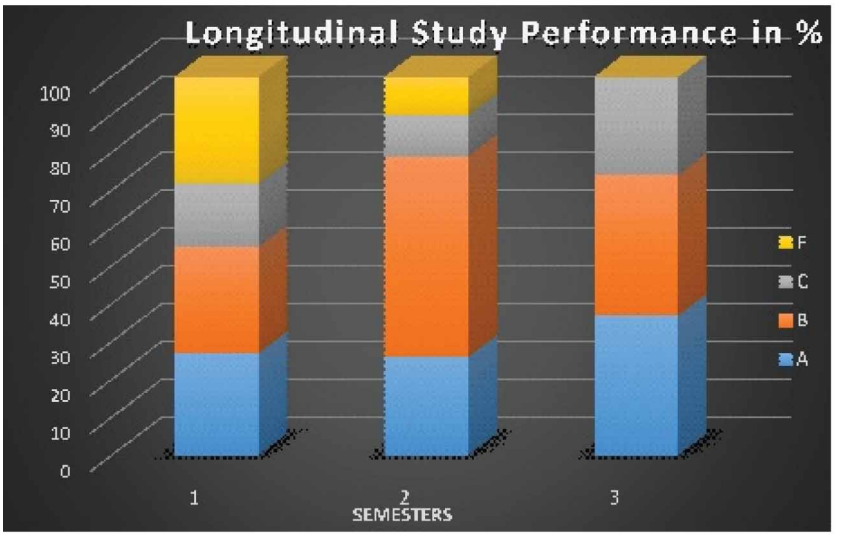
We wanted to look at the overall results of this study. Table 5 summarizes the three semesters of PDCA cycle results. Table 5 summarizes the results and Figure 2 provides graphical representation of the study over time.

It is clear that the PDCA cycle approach and corresponding treatments helped in designing and improving the performance of students in one of the learning objectives of the AIS course. Figure 2 summarizes the average scores by semesters. As noted in Table 5, in the third semester there were no failures. Student comments also suggested that students liked this approach as one student

Table 5. Summary of longitudinal study

Grade	Semester 1	%	Semester 2	% Semester 2	Semester 3	% Semester 3
A	17	27	14	26	10	37
B	18	28	28	53	10	37
C	10	17	6	11	8	26
F	18	28	5	10	0	0

Figure 2. Longitudinal study results



mentioned, "I liked the application of assignments." Another student commented, 'Instructor used many activities to teach." This, of course, is not an end itself. Technology is constantly evolving so is organizational structure. As Tornow (2015) noted, "soon the new-hire data entry position will be obsolete as computers take over and the whole process becomes automated; thus ushering accounting into the age of analysis and forecasting as opposed to book keeping and data entry". Education should continuously evolve to keep currency of courses and student's skills.

Act/Future

Though we did achieve our goa, the AIS course is a moving target. Technology is rapidly evolving and course must evolve with the technology. Researchers have emphasized the importance of data, which in the 21st century also includes unstructured data. Tornow (2015) discussed the needs of today's students and concluded, "students should be exposed to a multitude of different accounting software so that they learn to move beyond "point and click" to a stage of analysis that will allow them to adapt to whatever systems they see later in their careers. Dilla et al. (2015) went a step further and suggested teaching data visualization to detect fraud. Business intelligence is becoming important since accounting deals with raw data. There is abundance of data, students should learn how to analyze and extract "intelligence", be it to detect fraud or to improve processes. In a 2014 AICPA survey, researchers found electronic data analysis (big data) was number one issue for Forensic and valuation professionals. Business intelligence and Data mining are emerging rapidly and recently many researchers (Sivarajah et al., 2017; Richin et al., 2016; Dilla et al., 2015; Vasarhelyi et al.,

2015; Warren et al., 2015, etc.) have started focusing on them and their importance for accounting profession. Future PDCA iterations must include these important areas.

Following section discusses lessons learned, in general, and pitfalls to be avoided.

Lessons Learned

- Clearly identify all software to be used in the course at the start of the course;
- Measure student competencies in software and internet in general (for web and hybrid courses). We noticed several students lacked course management familiarity (SAKAI in this case) and did not know how to post files or navigate through the course. It is necessary to provide this expertise before they start the assignment;
- Provide hands-on practice(training) and post streaming videos of software used in the class;
- Have continuous online software training to avoid disappointments and frustrations;
- Create student's software accounts and allow pre class access to software for students who want to practice it before classes start;
- Provide information on technical support for online students;
- Keep cyber hours for online students to provide answers to assignment questions;
- If role playing is used to teach a concept, provide early start on the case. Students need time to understand the concept of role playing and collaboration and staging takes time.

Pitfalls to Avoid

Skill Portability

Do not assume once students learn a software they can port it to another software. For example, students who learned ACCESS were not able to learn IDEA on their own or with little guidance.

Time Management: Many students did not start the assignment before a day or two the due date. This causes last minute panic. Reinforcement of time management is necessary for assignments.

LIMITATIONS

This study provides a longitudinal assessment of an AIS course and future of AIS course. The results, however, should be interpreted with caution. This study used one learning objective of the course to assess progress. However, the AIS course has several learning objectives that should also be tested. Future research should replicate the PDCA cycle for a larger sample size. In addition, it may be desirable to study alternative treatments as many students shy away from role playing. Rebele et al. (2015) surveyed accounting research and concluded accounting research has become stagnant. They argue most research is based on surveys and tend to ignore important areas. They suggest studies (or even quasi-studies) methods to conduct research.

CONCLUSION

Accounting information systems are evolving with the technology. Technology and behavioral issues are making it more tempting and easier to commit fraud. It is important for accounting students to go beyond their discipline and learn accounting data mining and interrogation techniques (Arnold, 2018). This would help them understand how data and documents move, how controls can be placed in the process and how fraud can be detected. Information technology has both a good and a bad side. Students must be taught to use technology for "good", and to avoid and detect the "bad" of its usage. A sound knowledge of data processing is essential for students to detect fraud and ethical violations. AIS is a challenging subject since it is impossible for one individual to have expertise in

many discipline-oriented areas. However, we must find ways to teach students the ways to understand and mine accounting data to prevent and detect fraud and to find opportunities. Big data and business intelligence are the future of AIS and it is important our students should understand big data and its implication for audit, fraud, etc. (Mancini et al, 2016). This paper is an attempt in that direction.

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APPENDIX

Table 6. Rubric for control assignment

Category	A	B	C	F
Threat	Student was able to comprehend and identify at least four threats	Student was able to comprehend and identify no more than three threats	Student was able to comprehend and identify no more than two threats	Student was not able to comprehend and did not identify any issue or was not able to identify more than one issue
Control	Student was able to identify Controls	Student was able to identify most of the controls	Student was able to identify some controls correctly	Student was not able to identify controls correctly
Cost/Benefit	Student was able to perform most cost/ benefit analysis	Student was able to perform some cost/ benefit analysis	Student was able to identify some costs and benefits and was able to perform little analysis	Student was able to identify some cost/ benefits but was not able to perform cost/ benefit analysis
Controls (application)	Student was able to apply appropriate controls	Student was able to apply some controls	Student was able to apply few controls	Student was not able to apply appropriate controls
Ethical	Student was able to apply most ethical issues	Student was able to apply some ethical issues	Student was able to apply few ethical issues	Student was not able to apply issues

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