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A DevOps-based Service-Learning Design in An Advanced IS-related Course

Short Paper

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Abstract

This study examines a DevOps-based service-learning course design in an advanced IS-related course in Taiwan. Specifically, the researcher proposes to investigate teaching case to not only understand direct feedback from students but also retrieve some teaching tips for current course instructors when adopting project-based methods. This ongoing study introduces a course design for sophomore students who are major in management information systems in a consecutive two years. The inductive content analysis of 205 feedbacks from 246 student participants' responses addresses the proposed research questions and then further proposes three main findings. The preliminary findings of this study contribute to the research stream on information systems education and may provide an encouragement for instructors to be more involved in such DevOps-based service-learning courses.

Keywords: Information systems education, DevOps, Service learning, Exploratory study

Introduction

Information Systems (IS) is the academic field to discuss related issues on the information technology (IT) systems with users, developers, and administrators in the perspectives of management, system, technology, applications, organization, and society (Baskerville & Myers, 2009). Most of the companies in the industry expect that the institutes in higher education are able to cultivate future practical experts so that the college students will be able to earn experiences on system development and teamwork building before entering the IT industry (Lee et al., 2016). Students can save cost and energy on the exploration of uncertain career paths and become a valuable human resource right after joining the project team if they did enough practice during college.

However, the field of IS education, unlike the medical and catering areas, seldom targeted the design of practical training in the classroom to address the combination between IS coursework and IS practical skills. Popular issues such as learning with gamification applications (e.g., Huang & Cappel, 2005), instruction technology (e.g., Nelson & Hauck, 2008), flipped classroom (e.g., Davies et al., 2013), and learning strategies (e.g., Chen, 2002; Riordan et al., 2017) generally ignored the connection between the instruction and local practical issues. Instead, the research area of "project-based learning" (PBL) had been introduced and became the mainstream in the field of IS education to explore the development of students' skills for project management in class or the impact of students' enrolled practical sessions or hand-on courses. For example, Rawlings et al. (2005) proposed a "sandwich course" that students will choose one year during their college lives to find an internship in order to practice what they have learned in class. Smith et al. (2008) also argued that the practical sessions may be a possible channel to improve students' skill for project management.

To help students experience the practical operations in the classroom, project simulation is a common way to conduct in class. A typical example like Heim et al. (2005) created a simulated environment of IT consultation to ask students to work in groups to conduct decisions on procurements through the customer relationship management (CRM) system as IT consultants. The experiential learning was expected to make students know what the real world works. However, the simulation in the classroom cannot control all the environmental factors to make the whole process completely the same as the real one. Even though students may gain some experiences similar to the real scenarios, people may also feel that it is just a “learning through play” or a gamification process. Without the real scenarios, students will not be able to apply the knowledge learnt from coursework to the actual realm with necessary boldness and adequate judgment.

To fill the gap for the lack of real experience in the PBL, this study introduces a DevOps-based service-learning practice in an advanced IS-related course. The purpose of the learning strategy design is to assist students combine what they have learnt in class with the practical processes to solve the real problems for surrounding units or companies in their daily lives. Through the collaboration with businesses or organizations around the campus, students will be able to learn the characteristics of local communities and solve the real proposed problems using the knowledge of database design and business administration. The results from the DevOps-based service-learning practice can be also displayed in the real settings to enhance students’ senses of belonging to their communities around campus and improve the senses of accomplishment to apply their knowledge learnt to the real world.

Theoretical Background

Project-based service learning

The idea of project-based learning (PBL) has been a popular research target in recent years (especially in the areas related to educational studies such as IS education) because the needs of improving the design of teaching in class with the support of simulated projects are continuously proposed by the instructors at the teaching sites. For example, Guo et al. (2020) explored the past studies on PBL and then pointed out that most past scholars have tried to explain the impact of PBL on students’ learning outcome mentally or physically. According to the list in the paper, the cases of PBL in the past studies are generally not restricted to a specific attribute of the project and are mostly only revealed by the self-disclosure from students.

Unlike the papers introduced in Guo et al. (2020), the study conducted in Grotta & Prado (2021) was a unique example because the concept of DevOps-based learning was introduced with PBL into the teaching sites. DevOps is a combination of operating culture, practices, and tools originated from the software engineering field to combine the system developers and operators (Airaj, 2017; Grotta & Prado, 2022). By analyzing students’ learning outcome from two Brazilian courses of “software quality assurance” and “website development”, the scholars discussed how the DevOps-based learning method based on “design science methods” improve students’ learning outcome and motivations in the field of IS. Our study will adopt the method similar to Grotta & Prado (2021) to explore students’ learning results (the Devs) by introducing practical projects (the Ops) in class. However, we will not only adopt the concept of PBL and DevOps but also introduce the idea of service learning with the topics related to local issues or businesses around campus to further improve learning motivation.

Service learning is a learning design method to lead students to provide service to the local organizations (Eyler, 2002). In the IS, one of the most common ways to conduct service learning is to collaborate with educational organizations to teach basic skills of documenting or programming using IT in the elementary schools of remote areas. For example, Hashemite University cooperated with the community service-learning center in Jordan to invite students to be directly involved in the information systems projects of the center (Al-Khasawneh & Hammad, 2013). The authors found that students generally felt positive when applying coursework to reality. Nevertheless, the considerable efforts and time that both students and instructors need to devote in the project may reduce the learning outcome and motivation because of the large scope of the projects. In our study, we will restrict the scope of the projects to make students be able to finish in one semester but keep the possible extensions for the projects if both students and the collaborated unit wish to continue after our course finishes. The actual learning outcome from the DevOps-based service-learning practice will be the main target that we need to observe in this study.

Research Method

A qualitative case study was conducted with a semester-long observations, official course evaluations, and unofficial surveys. Case study is a research method appropriate for this study because it can help us identify potential opportunities and rich elements from the participants' behaviors under the specified observable settings (Myers, 2019). Through the case, we will be able to explore the specific context of DevOps-based service-learning practice with various detailed information over time (Creswell & Poth, 2016).

Specifically, researchers designed the course and invited students to participate in the course at the beginning of the semester. During the semester, periodic observations and follow-ups on the collaboration between students and local organizations should be conducted. The course evaluations can also support our findings through observation. Because the major purpose of this research is to discuss the growth of the students' learning motivation and outcome from the DevOps-based service-learning design, we need to focus on the feelings from our participants which cannot be transformed into numbers appropriately. A total of 205 feedbacks from 246 students (60 detailed comments with identification and 14 anonymous official evaluations in spring 2021; 95 detailed comments with identification and 36 anonymous official evaluations in spring 2022) have been collected and analyzed. Through the sincere feedback from students, researchers would be able to know whether the new design can help students' learning and thus adjust the teaching strategies to improve the course design. The discussion with local communities can also assist researchers identify the benefit from the service-learning practice and enrich the relationships between the classroom and the surrounding businesses.

To help our students finish the course projects on time with adequate basic skills learnt from the lectures, five teaching assistants were hired to assist the course. The duties of the teaching assistants include lecture assistance, student communication, exam proctoring, e-learning platform design & maintenance, data collection & organization, and discussion sessions / computer lab preparation. Specifically, each group of students should meet with the teaching assistants at least three times to discuss their ideas and system design for their course projects. The teaching assistants should be able to lead the discussion and provide suggestions or solutions to help students continue their system development. Generally, we spent 40 to 60 minutes for each discussion outside the lectures and TA sessions. In other words, a total of at least additional 3,000 minutes was involved for both instructor and teaching assistants during one semester. Besides, a 120-minutes computer lab session held each week could help students know how to operate the necessary software to develop their information systems.



Figure 1. Course Observation during Students' Project Discussions

Case Background

The course of “Database Management Systems” is a required course for the departments of management information systems, information management, or computer information systems in Taiwan. Generally, every school arranges this course in the second year of the four-year college course designed for sophomores to learn the basics of relational database systems and the related structured query language (SQL). After finishing this course, students will attend their junior year and start to work with a professor on a graduation IS project for at least one year. Because various professors may provide different instructions on guiding the graduation project, students may experience and learn differently through the instruction. To help students develop the basic skills consistently and prepare for the upcoming graduation project, the course of “Database Management Systems” is the best place to design a course project for students to design a semi-complete information system (the development in the DevOps). Moreover, the DevOps-based service-learning design for the course project can also facilitate students applying the knowledge related to transactional or NoSQL databases to real situations (the operations in the DevOps) and thus increase students’ learning motivation. The results for the course project may be expressed as an automated sales system for the business that sells lunch boxes or a social media marketing platform that promotes local cultural activities. Through the exhibitions gluttoned with students’ daily lives, the feelings on the realization of the coursework to the practical areas will be enhanced. It is also possible to increase people’s sense of identity as a member of the local community and thus create an interactive environment between students and the local residents around the campus.

The researchers of this study attempted to apply the DevOps-based service-learning projects to the course design during the two semesters in Spring 2021 and 2022 separately. A total of 121 students and 125 students joined the course of “Database Management Systems” in the different two semesters. The major component of the students is from the Department of Management Information Systems with about 20 students from other majors such as business administration, finance, international business, statistics, economics, and computer science. We asked students to form groups with five members only and find the topics that can collaborate with local communities. The list of the project teams with topics has been displayed in the following Table 1.

Spring 2021		Spring 2022	
#	Topics	#	Topics
1	Course selection system (w/ academic affairs office)	1	Café evaluation system (w/ local cafés)
2	Leave management system (w/ personnel office)	2	Book interexchange platform (w/ local non-profit units)
3	Pick-up on-demand system (w/ convenience stores)	3	Drinking recommendation mobile application (w/ local drinking businesses)
4	Life entertainment system (w/ student union)	4	Travel diary platform (w/ local traveling club)
5	Delivery platform ranking system (w/ delivery platforms)	5	Learning outcome supervision system (w/ local study groups)
6	Health management system (w/ local businesses)	6	Friend matching mobile application (w/ local developer club)
7	Grouping system (w/ local businesses)	7	Movie commentary platform (w/ local entertainment club)
8	Used item finding system (w/ local non-profit units)	8	Course selection support system (w/ academic affairs office)
9	Cocktail recipe system (w/ local bistros)	9	Fitness area management system (w/ physical education division)
10	Dormitory renting system (w/ housing division)	10	Vaccination verification system for air passengers (w/ airlines)

11	Banking service recommendation system (w/ local financing club)	11	Logistics system (w/ local businesses)
12	Bakery operation system (w/ a local bakery)	12	Activity arrangement system (w/ student activity division)
13	KTV ordering system (w/ a local karaoke business)	13	Online ordering system (w/ a local restaurant)
14	Online clothing ordering system (w/ local clothing businesses)	14	Course selection information system (w/ academic affairs office)
15	Supply chain system (w/ a local business)	15	Clothing management system (w/ a local clothing store)
16	Volleyball court reservation system (w/ physical education division)	16	Classroom renting platform (w/ academic affairs office)
17	Transactional strategy platform (w/ local financing clubs)	17	Cram school management system (w/ a local cram school)
18	Fitness matching system (w/ local fitness businesses)	18	Expiring food items matching platform (w/ local restaurants)
19	Old clothing system (w/ local non-profit units)	19	Campus human resource agency platform (w/ local businesses)
20	Accommodation matching platform (w/ housing division)	20	Traveling information platform (w/ local traveling club)
21	Food map mobile application (w/ local restaurants)	21	Course information platform (w/ academic affairs office)
23	Course evaluation platform (w/ academic affairs office)	22	Need fulfillment platform (w/ local units and clubs)
24	Fitness control mobile application (w/ local fitness businesses)	23	Restaurant recommendation system (w/ local restaurants)
		24	Restaurant ordering system (w/ a local restaurant)
		25	Library seating reservation system (w/ campus library)
Table 1. A List of the Project Teams in the Course for this Study			

Preliminary Finding & Discussion

The course design with the DevOps-based service-learning practices generally received positive feedback from students. After receiving the feedback, researchers created a united form to collate all the narratives and then adopt qualitative content analysis to retrieve highlights from the raw data. In the following analysis, we will highlight the three main findings that we identify from the practice to help readers know how this course development improves students' learning outcome and motivation.

Adequate scope matters

One of the challenges faced by past courses that used PBL design to improve learning motivation was the inadequate scope of the project provided during the semester. In Taiwan, where a semester typically lasts 18 weeks, students are expected to not only learn the basic concepts of the course to construct their basic skills, but also apply that knowledge through developing an information systems project. If the project scope is too narrow, students are unable to apply the knowledge from the coursework to practical situations. Conversely, if the proposed information systems require considerable time and effort to develop, students won't finish the course project on time. Therefore, an adequate scope for the course project is critical to the

success of a PBL design. Adequate scoping can help both the instructor and students settle on the required elements of the project at the beginning of the semester and better understand what needs to be done before the semester ends.

“I really like the large enough scope of the project to let us experience what we will need to take care of in the upcoming graduation project. Overall, I really enjoy the complete planning of the course. I do learn a lot.” (Anonymous feedback from our student)

The scope of the course project should be adjusted based on the length of the semester and the participants' majors. In our case, the DBMS course is a required course for sophomore students majoring in management information systems who have experience with basic programming practices and system design concepts. Therefore, a semester-long project to develop an information system would be adequate. If the instructor is guiding a more basic course, such as an introduction to programming, students may need a course project with a narrower scope because they'll need to learn new knowledge first to be able to develop the systems in practice.

To emphasize the importance of scoping in PBL design, Gupta (2022) discovered that a well-defined project scope can increase student engagement and motivation on projects. Furthermore, Chiang and Lee (2016) revealed that a sufficient project scope can assist students in developing a deeper understanding of the course material and enhancing their overall learning experience. Our findings support these conclusions and apply them specifically in the IS field.

In summary, an adequate scope of the project is critical to the success of a PBL design. It is important to consider the length of the semester and the participants' majors to determine the appropriate scope. A project with a scope that is too small will not provide enough practical experience, while a project with a scope that is too large will not be completed on time. By striking a balance between these two extremes, both instructors and students can benefit from a successful PBL design.

Passion on instruction counts

Based on feedback received from our students, the instructor's passion for teaching directly and significantly affects students' motivation to learn. Here are a few examples of anonymous feedback from students:

“Thank you for your instruction and hard-work during the whole semester. I can feel you are very proactive and passionate about participating in the course. You also take care of students' learning situation and outcome to adjust your instruction. Overall, I learned a lot from the course.”

“I had never met an instructor like you who is so serious about instruction. The instructor not only taught the course with full passion but also involved in all the discussions on students' projects among all the groups with the teaching assistants. Thank you for your diligence! Just because the instructor is so serious on the course, we all want to finish the course project with hard-work.”

More than half of our students expressed that the instructor's passion affects their motivation to learn from lectures and course projects. As DevOps-based service-learning practice requires considerable time and effort, students need a benchmark or a role model who is passionate enough about the practice to follow. The instructor is the best person to become that role model because they are knowledgeable about the whole process and are powerful enough to control all possible incidents that may occur during the semester.

In fact, past scholars in the education field have highlighted the importance of a role-model facilitator to foster students' learning motivations and outcomes (e.g., Lunenberg et al., 2007; Uerz et al., 2018). However, most relevant studies have focused on general teaching cases, especially in primary or secondary schools. Undergraduate students have become a somewhat neglected target for role-modeling education research, probably because people do not believe these adolescents with mature thinking need role models anymore. Faculty may be a role model for students' selection of academic majors (e.g., Akbulut, 2016; Rask & Bailey, 2002), but not an apparent influencer to drive their learning motives. Instead, practitioners or peers provide more benchmarking impacts on these students who have already come of age or are close to it (e.g., Gamlath, 2022; Jack et al., 2017). Moreover, the impact of course instructors, especially in IT-related majors, has been underestimated during the recent decades since emerging technologies have raised their role in supporting students' learning progress (e.g., Alavi & Gallupe, 2003; Gan et al., 2015). Indeed,

useful IT tools and platforms do help. Nevertheless, students will be more encouraged to be involved without course instructors' complete dedication to teaching and guidance. The findings of this study reinterpret and reconfirm the importance of passion in instruction from college-level teachers and professors.

In addition to the course instructor, the teaching assistants' passion also matters. Teaching assistants are the frontline contacts with students, so students usually get more connected with these skilled helpers of the course. Students will be able to follow the teaching assistants' guidance carefully only if teaching assistants are willing to devote time and effort to guiding them.

“I can feel the passion and hard-work of the professor to design the whole DBMS courses, as well as the TA who prepares the TA courses very well. All of you deserve a lot of praise.”

Based on the feedback received, it can be concluded that the passion of teaching assistants is just as important as that of the course instructor. Teaching assistants are the first point of contact with the students, and therefore, they play a crucial role in connecting with them. Students are more likely to follow their guidance and instructions if teaching assistants are willing to devote their time and effort to guiding them.

Overall, it is clear that the passion and dedication of instructors and teaching assistants have a significant impact on students' motivation to learn. These individuals act as role models for their students, and their commitment and enthusiasm can inspire students to work harder and achieve more. It is important for educational institutions to recognize the crucial role played by instructors and teaching assistants in the learning process and to provide them with the support and resources they need to succeed.

Connection between concepts and practices affects

Students are often concerned about how to apply the knowledge they learn in lectures to practical areas. Since most students will need to find jobs in industry after graduating from college, they will be satisfied with their courses if they understand that what they learn is not just theoretical, but also practical. In our course design, we have created an immersive learning environment with intensive discussions among students and teaching assistants. Through these discussions, students can identify their weaknesses and find solutions for their system development.

“I feel that the best part for this course was the discussion with the professor and teaching assistants. The discussions after classes with my group members also help me learn a lot. The process of discussions does help me make flexible use of knowledge from coursework, so I hope the professor can continue keeping this part in the future.”

“The meetings with teaching assistants on discussing the system prototype helped a lot with our project because we can clarify the problems such as the scope of the project and the correctness of our entity-relationship diagram.”

“During the process of discussion and the system development, I encountered multiple scenarios that were different from what I expected. Because I am a beginner in system development and operation, I often found that I had no ability to solve the problems that my team members met. Those situations motivated me to further learn more on the related technical skills.”

Overall, the students' feedback highlights the value of discussion and collaboration in the learning process. By engaging in discussions with both their peers and teaching assistants, students were able to apply their theoretical knowledge to real-world problems and develop practical solutions. This approach not only helps students to identify their weaknesses and areas for improvement, but also fosters a sense of teamwork and cooperation among group members.

In addition to the benefits of discussion, the students also emphasized the importance of hands-on learning. By working on real projects and encountering unexpected scenarios, students were able to develop their problem-solving skills and gain practical experience. This experience will be valuable to them as they enter the workforce and begin their careers in industry.

In summary, the course design that incorporates discussion and hands-on learning has been successful in helping students to link theoretical knowledge to practical applications. By continuing to prioritize these

elements in future course designs, professors can ensure that students are well-prepared for the challenges they will face in their careers.

Conclusion & Further Ongoing Development

This study has successfully completed practical DevOps-based projects in collaboration with local businesses and organizations around the campus, utilizing both information technology and management knowledge to improve their performance and brand value. The outcomes of these practical projects may be further implemented in the field, such as developing cash flow information systems for businesses, helping with brand marketing via social media strategies, or aiding local organizations in creating innovative business models. Student learning outcomes can be assessed not only through mid-term and final exams but also through written reports, video presentations, and system demos in the end of the semester. Results and further analysis from the ongoing semester (Spring 2023) of the same course will help us validate what we have concluded above. As this teaching model has been proven to be viable in this case study, it is expected to be applied to other IS courses in the future, or to develop information systems and management practical project-based application courses that align with the concept of university social responsibility.

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