TRU SoTL Scholars Program

2025 Cohort

Snapshot A

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CELT will share your project title and summary on its website and in reports. Please notify the Director if you have concerns or questions.

Project Title

Translating Cloud Architect Competencies into Practical Cloud Computing Course

Project Summary (100-200 words)

The rapid adoption of cloud technologies creates significant demand for software engineers skilled in cloud architecture, yet traditional curricula often struggle to impart the necessary practical competencies. This SoTL project addresses this gap within “SENG 4620: Practical Cloud Computing” at Thompson Rivers University. The primary goal is to redesign the course to effectively prepare undergraduate software engineering students for entry-level Cloud Architect roles. Employing an Action Research methodology, this study will first identify core industry-required competencies by analyzing job descriptions and certifications, then translate these into measurable learning outcomes to guide the course redesign. The redesigned course will integrate foundational theory with intensive hands-on practice through scaffolded individual labs, using Infrastructure as Code (IaC) and cloud education accounts (e.g., AWS Educate) to overcome common logistical barriers. A semester-long group project will simulate professional practice, requiring students to collaboratively design, implement, and justify cloud solutions. The project's effectiveness will be evaluated through student performance (to assess competencies) and self-reported questionnaires (regarding their perceived preparedness for industry). Instructor feedback will also be analyzed to reflect on student performance and the course delivery.

Research Question

1. How can “SENG 4620: Practical Cloud Computing” be effectively redesigned, implemented, and assessed to demonstrably enhance undergraduate software engineering students' attainment of industry-aligned competencies for entry-level Cloud Architect roles?

The following sections are for you to communicate with the CELT team your current state of thinking about your project. Your plans will evolve and may significantly change over the next couple of months.

Project Methodology (include references)

This study will utilize an Action Research (AR) framework [Kemmis, 2006]. AR is selected for its suitability in practitioner-led educational research, allowing for systematic inquiry and iterative improvement. The research will proceed through cycles of planning, acting, observing, and reflecting [Stephen Kemmis and Robin McTaggart, 2014].

Phase 1: Planning & Design: This initial phase focuses on planning and design. First, competencies will be identified through a systematic analysis of industry requirements for entry-level Cloud Architects, reviewing job postings, certification syllabi (AWS, Azure, GCP), relevant literature, and potentially incorporating expert consultation (e.g., Delphi method [Linstone et al., 1975]) [Ozyurt et al., 2022]. Dobslaw et al. [Dobslawet al., 2023] investigated the knowledge gap between software engineering curricula and industry demands by developing the Job Market AnalyseR (JMAR), a text-analysis tool designed to identify discrepancies between academic offerings and industry needs. Assyne et al. [Assyne et al., 2022] conducted a systematic mapping study of 60 primary studies to review the state of research on software engineering competencies and identified 49 unique essential competencies. Second, Learning Outcomes will be developed by translating the identified competencies into specific, measurable, achievable, relevant, and time-bound (SMART) learning outcomes for SENG 4620. Third, the curriculum and assessments will be redesigned. This involves developing revised course materials, including lecture content, scaffolded individual laboratory exercises [Van Der Stuyf, 2002], a structured semester long group project, and aligned performance-based assessment instruments (e.g., analytic rubrics. Concurrently, data collection tools (surveys, interview guides) will be finalized, and ethical approval will be secured from the Thompson Rivers University Research Ethics Board (REB).

Phase 2: Implementation (Acting): The course is scheduled to be offered in Fall 2025 with an anticipated enrollment of 15 to 20 students. The redesigned SENG 4620 course, incorporating the new pedagogical strategies and assessments, will be delivered during this academic semester.

Phase 3: Data Collection (Observing): Data sources will include student assessment results, pre/post-course surveys measuring perceived competency and preparedness, qualitative data from student focus groups or interviews, analysis of student work artifacts, and systematic instructor reflections.

Phase 4: Analysis & Reflection: Collected quantitative and qualitative data will be analyzed to evaluate the extent to which the redesigned course achieved its intended learning outcomes and addressed the research questions. Findings will identify strengths, weaknesses, and areas for further refinement. This

reflection will inform the planning phase of subsequent AR cycles for continuous improvement and sustainability of the course based on evidence.

Data Collection Methods

Data will be collected using the following methods:

1. Systematic review of academic literature, industry job postings, major cloud provider certification guides (AWS, Azure, GCP), and skills frameworks.
2. (If Feasible) Feedback from industry professionals on required competencies (e.g., using a simplified Delphi method or structured interviews).
3. Student performance data (Quantitative).Scores/grades from individual lab assignments, group project deliverables (e.g., architecture documents, IaC code, reports, presentations), and exam components. Evaluation will utilize standardized analytic rubrics aligned with learning outcomes.
4. Student perceptions (Quantitative & Qualitative): Data gathered using pre/post-course surveys. Anonymous online surveys will be administered at the beginning and end of the semester. Potentially, semi-structured interviews or focus groups will be conducted with a volunteer sample of students to gain in-depth insights into their experiences with labs, group project dynamics, theory/practice balance, assessment clarity, and encountered challenges.
5. Student work artifacts (Qualitative): Collection of selected samples of student work (e.g., project design documents, specific lab submissions, IaC code repositories) for qualitative analysis focusing on design thinking, justification of choices, and application of architectural principles.
6. Instructors reflections (Qualitative): Systematic reflective journal entries maintained by the instructor and RA throughout the semester, documenting observations on student engagement, learning patterns, effectiveness of pedagogical strategies, logistical issues, and interpretations of student performance and feedback.

Data collection instruments, including survey questions, interview/focus group protocols, and assessment rubrics, will be developed and refined during the planning phase. Consent forms and recruitment materials will comply with TRU REB requirements.

Data Analysis Methods

Quantitative Data Analysis:

- Descriptive Statistics: Means, standard deviations, and frequencies will be calculated for student performance data (rubric scores from labs, projects, exams) and quantitative survey responses (Likert scales) to summarize overall performance and perceptions.
- Inferential Statistics: Paired t-tests may be employed to compare pre/post survey data on self-reported confidence and preparedness (subject to checks for statistical assumptions).

Qualitative Data Analysis:

- Thematic analysis will be used to analyze qualitative data from open-ended survey questions, focus group/interview transcripts, and instructor/RA reflective journals.

- Content analysis will be applied systematically to student work artifacts (e.g., design documents, IaC code) to identify and evaluate the presence and quality of specific elements demonstrating targeted competencies (e.g., application of security principles, justification of architectural trade-offs).

Human Research Ethics Considerations

This research involves human participants (students enrolled in SENG 4620 and potentially experts from industry). We will strictly adhere to TRU's REB policies and the ethical principles outlined in the TCPS2 2022. The Principal Investigator and the Research Assistant will complete the TCPS 2: CORE (Course on Research Ethics) tutorial prior to engaging in any research activities.

Formal ethics approval will be sought and obtained from the TRU REB via the ROMEO system prior to initiating any recruitment or data collection activities involving students. In addition, a comprehensive informed consent process will be implemented. Potential participants will receive clear, accessible information (using TRU REB approved forms and recruitment materials) detailing the study's purpose, procedures, expected duration, potential risks and benefits, the voluntary nature of participation, confidentiality and anonymity measures, data storage and usage plans, and their explicit right to withdraw at any time without penalty or impact on their academic standing or grades in the course. Separate consent may be sought for different data components (e.g., surveys vs. interviews).

In addition, recognizing the inherent power dynamic between the instructor-researcher and students, where feasible and appropriate, recruitment and consent procedures for more qualitative data (e.g., interviews) will be handled by the Research Assistant or conducted after final course grades have been submitted to minimize perceived pressure.

Finally, all research data will be stored securely on password-protected TRU systems or encrypted devices accessible only to the research team. Data will be retained for the period specified by TRU REB guidelines and then securely destroyed.

Knowledge Mobilization

Target Audiences: Colleagues within the Software Engineering program, Computing Science department, Faculty of Science, and the CELT, and participating students are internal audiences. Engineering and Computer Science Education Communities, SoTL Community, and Industry Partners are external audiences.

Dissemination Activities: Findings will be presented at relevant local (e.g., TRU SoTL Conference/Showcase), national (e.g., Canadian Engineering Education Association - CEEA), and potentially international conferences (e.g., SIGCSE).

Publications: Manuscripts will be prepared for submission to peer-reviewed journals in engineering education (e.g., IJEE, IEEE Transactions on Education), computer science education (e.g., ACM TOCE), or SoTL (e.g., IJSoTL, Teaching & Learning Inquiry).

Expected Outcomes

- A revised, evidence-informed curriculum for SENG 4620 that is demonstrably better aligned with the competencies required for entry-level Cloud Architect roles.
- Presentations at peer-reviewed national and/or international conferences.
- Publication(s) in relevant peer-reviewed journals focused on engineering education.
- Provide the foundation for designing a Cloud Computing micro-credential program for broader access within BC.

Research Team

- Sina Keshvadi, Assistant Professor, Software Engineering, Department of Engineering, TRU.
- One Student Research Assistant.

References

1. [Assyne et al., 2022] Assyne, N., Ghanbari, H., and Pulkkinen, M. (2022). The state of research on software engineering competencies: A systematic mapping study. Journal of Systems and Software, 185:111183.
2. [Dobslaw et al., 2023] Dobslaw, F., Angelin, K., Öberg, L.-M., and Ahmad, A. (2023). The gap between higher education and the software industry–a case study on technology differences. arXiv preprint arXiv:2303.15597.
3. [Foster et al., 2018] Foster, D., White, L., Adams, J., Erdil, D. C., Hyman, H., Kurkovsky, S., Sakr, M., and Stott, L. (2018). Cloud computing: developing contemporary computer science curriculum for a cloud-first future. In Proceedings Companion of the 23rd Annual ACM Conference on Innovation and Technology in Computer Science Education, pages 130–147.
4. [Foster et al., 2019] Foster, D., White, L., Erdil, D. C., Adams, J., Argüelles, A., Hainey, B., Hyman, H., Lewis, G., Nazir, S., Nguyen, V., et al. (2019). Toward a cloud computing learning community. In Proceedings of the Working Group Reports on Innovation and Technology in Computer Science Education, pages 143–155.
5. [Kanuka, 2011] Kanuka, H. (2011). Keeping the scholarship in the scholarship of teaching and learning. International Journal for the Scholarship of Teaching and Learning, 5(1):3.
6. [Kemmis, 2006] Kemmis, S. (2006). Participatory action research and the public sphere. Educational action research, 14(4):459–476.
7. [Linstone et al., 1975] Linstone, H. A., Turoff, M., et al. (1975). The delphi method, volume 1975. Addison-Wesley Reading, MA.
8. [Ozyurt et al., 2022] Ozyurt, O., Gurcan, F., Dalveren, G. G. M., and Derawi, M. (2022). Career in cloud computing: exploratory analysis of in-demand competency areas and skill sets. Applied Sciences, 12(19):9787.
9. [Paterson et al., 2021] Paterson, J., Adams, J., White, L., Csizmadia, A., Erdil, D. C., Foster, D., Hills, M., Kazmi, Z., Kuber, K., Nazir, S., et al. (2021). Designing dissemination and validation of a

framework for teaching cloud fundamentals. In Proceedings of the 2021 Working Group Reports on Innovation and Technology in Computer Science Education, pages 163–181.

10. [Saligrama et al., 2025] Saligrama, A., Ho, C., Tripp, B., Abbott, M., and Kozyrakis, C. (2025). Teaching cloud infrastructure and scalable application deployment in an undergraduate computer science program. In Proceedings of the 56th ACM Technical Symposium on Computer Science Education V. 1, pages 1015–1021.
11. [Stephen Kemmis and Robin McTaggart, 2014] Stephen Kemmis, S. K. and Robin McTaggart, R. M. (2014). The action research planner: Doing critical participatory action research. Springer.
12. [Van Der Stuyf, 2002] Van Der Stuyf, R. R. (2002). Scaffolding as a teaching strategy. Adolescent learning and development, 52(3):5–18.

[redacted]

Questions, concerns, anticipated challenges

- A key challenge involves aligning the identified competencies with the existing official learning outcomes and prerequisites of SENG 4620.
- Ensuring reliable student access to cloud platform resources and managing potential costs are anticipated challenges.
- Effectively managing group dynamics, ensuring equitable contributions, and addressing potential conflicts within the semester-long group project are known to be significant challenges.
- Obtaining sufficient voluntary student participation for qualitative data collection can be challenging.