

DELIVERABLES AND REPORT

Software Architecture Teaching: A Systematic Review (Project ID: 2025-S1-38)

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1. Introduction

This project undertakes a systematic review of software architecture (SA) education, aiming to provide a comprehensive synthesis of current teaching practices, challenges and outcomes within the field. With this project, we aspire to inform academic practitioners, educators, and curriculum designers of the key findings, offering evidence-based insights that can guide the development of more effective and industry-aligned SA teaching strategies. Our research was motivated by the persistent gap between academic practices and industry expectations, and the limited attention paid to students' learning challenges in existing mapping studies. Our research objective was to conduct a more integrated understanding of how SA teaching strategies assess their students, their outcomes, and equip them with the industrial required skills and knowledge, as well as the challenges, particularly from the student perspective. Given the evolving demands of the software industry, it is essential to evaluate how current educational practices prepare students for real-world challenges.

To achieve this, we employed the Kitchenham Principle, a systematic review methodology, which follows a rigorous, transparent, and replicable process for identifying, selecting, and synthesising relevant research studies (Kitchenham and Charters 2007). This approach allowed us to gather evidence from 82 peer-reviewed articles published between 2010 and 2024, ensuring a comprehensive and unbiased overview of the field. Through this extensive review, several key findings emerged, marking significant achievements of the research. Ten recurring teaching themes were identified, with similar strategies grouped together to ensure thematic coherence. Among these, Project-Based Learning (PBL) stood out as the most widely adopted and effective strategy, primarily due to its strong alignment with real-world practices that are essential for industry readiness. Additionally, student motivation was recognized as a critical factor, significantly influencing learning outcomes and overall academic performance. The effectiveness of each teaching strategy was evaluated using Bloom's Taxonomy, assessing the cognitive levels at which students were engaged. This evaluation highlighted the importance of considering how teaching methods support higher order thinking skills, reinforcing the need for strategies that not only impart knowledge but also promote deeper understanding, application, and analysis.

In terms of assessment, summative methods such as exams and final projects were the most used. However, the findings suggest that experiential assessment focusing on real-time, hands-on evaluations provides a more comprehensive understanding of student capabilities and promotes deeper learning. Despite notable advancements in SA education, several challenges persist. Students often struggle with the abstract and conceptual nature of the subject, compounded by heavy workloads and limited access to practical experiences. Educators, on the other hand, face difficulties stemming from insufficient training in delivering SA content effectively and managing curriculum demands. To address these issues, the study recommends the incorporation of scaffolded learning techniques, the use of visual modelling tools, and the inclusion of real-world case studies in course design. These strategies are essential for bridging the gap between theory and application, making SA education more engaging, practical, and aligned with industry needs.

In conclusion, this review not only highlights the current state of software architecture education but also offers a roadmap for educators and institutions seeking to enhance instructional practices and better prepare students for professional success.

2. Restatement of the scope and requirements

The overall scope of the project remained consistent, which was to develop a draft report written in an academically appropriate style that summarises the methodology, findings, and key insights from the reviewed literature on software architecture education. However, as the research progressed, the research questions evolved to better reflect the depth and breadth of the literature and to capture more comprehensive insights into the topic. This refinement was made upon the recommendation from the project sponsor, who advised broadening the focus to ensure a more structured and multi-dimensional analysis of software architecture education.

The initial Research questions:

1. Which teaching strategies in software architecture education best align with industry expectations and requirements?
2. What are the key challenges educators face in implementing effective teaching strategies for software architectural learning?
3. How do various teaching strategies affect students' academic performance in software architecture courses?

Revised Research Questions:

1. What are the different teaching strategies used in software architecture education?
2. How are students provided with hands-on practical experiences related to software architecture teaching?
3. What are the various assessment methods used to evaluate student learning?
4. What are the outcomes of software architecture teaching strategies?
5. What challenges do students and educators face with the current software architecture teaching approaches?

The original questions were limited in scope, primarily emphasising alignment with industry and educator challenges. As the review unfolded, it became clear that other essential aspects, such as practical experiences, assessment methods, and diverse learning outcomes, needed to be addressed to provide a holistic understanding of software architecture education. The refined questions were more structured and interrelated, enabling a systematic approach to categorising the findings. This ensured the review could more effectively synthesise diverse studies into a coherent narrative, aligned with best practices for systematic literature reviews.

Initially, we included subheadings under the research questions, however, at a later stage, we decided to remove RQ1.a, as its content was sufficiently addressed within the discussion section. The question was “*Which teaching strategy aligns with industry expectation and requirements?*”

Questions on hands-on practical experiences in RQ2 and assessment methods in RQ3 allowed for a more practical evaluation of how students engage with content beyond theoretical knowledge, directly addressing industry readiness in a more detailed manner. The revised RQ5 expanded the focus from just educator challenges to include both student and educator challenges, allowing for a more comprehensive analysis of the learning environment.

This report has been written from a student perspective, focusing on how teaching strategies, assessments, and practical experiences in software architecture education affect student engagement, learning outcomes, and industry readiness. It addresses a gap in existing research by highlighting the student experience, offering insights to support more effective, student-centred teaching practices.

3. Project Outcome

3.1 Deliverables

Based on our project plan, there are six deliverables to be achieved, including project proposal and plan, systematic review, draft report, poster, final report and presentation. All these deliverables are completed before their due date and aligned with the initial project objectives, as detailed below:

- ***Project Proposal and Plan***

A detailed plan outlining the project scopes and boundaries, approach, requirements, etc., has been completed before the required deadline and submitted for review. Feedback from our sponsor is carefully considered in the development of the following deliverables.

- ***Systematic Review***

Following the plan in our project proposal, a total of 82 papers were fully reviewed by our team, based on which teaching themes, assessment approaches, outcomes and challenges are synthesised. This meets the planned review of at least 50 papers from 2010 to 2024. This systematic review serves as the foundation of our project objectives because it provides relevant data for us to synthesise teaching themes and further analysis and evaluation.

- ***Draft Report***

Multiple iterations of the report were produced. The first draft version was finished two weeks before the due date, covering all essential sections required in the final report. This draft version was reviewed during a scheduled sponsor meeting. Three successive drafts followed, and our team gradually refined our draft, and the second-to-last version was finished five days before the due date for final review and feedback.

These draft reports reflect the process by which we improve our report quality and seek constructive feedback from sponsors and instructors, aligning with our purpose to provide high-quality systematic reviews on SA education.

However, due to the Easter and Anzac holidays, we were unable to arrange a final consultation with our sponsor. This experience highlighted the importance of accounting for public holidays in project scheduling, a key lesson for future time management.

- ***Poster***

The academic poster was developed in compliance with E1 requirements and guided by the “KISS” principle (Keep It Simple and Straightforward). The final product is a digital A0-sized poster (841x1189 mm) that presents a concise and comprehensive visual and textual summary. It covers key sections including Abstract, Background/Motivation, Methods, Results, Key Findings, Conclusion, and additional elements such as references, acknowledgements, and sponsorship.

- ***Final Report***

Our final report is a comprehensive document including all the elements of an academic research project, from abstract to conclusion and future research directions. This is the major outcome of our project, representing our main efforts and contributions, which is also the foundation of all other deliverables, including our poster and presentation. This final report is further refined to meet the IEEE format to be published in the conference.

- ***Presentation***

This is our final deliverable to present our results and findings to stakeholders, including our sponsor, instructor, unit converter, academic scholars in SA education and stakeholders who are interested in this field.

The poster, final report, and presentation are closely aligned with our objective of effectively communicating our research findings to relevant stakeholders. These deliverables serve distinct but complementary purposes in communicating our work. The final report provides a comprehensive illustration of our research process and outcomes, directly addressing the research questions through detailed analysis and literature support. The presentation is designed to communicate our key findings clearly, aiming to “sell” the value of our research to the wider academic and professional community. Meanwhile, the poster serves as an “advertisement” to attract attention and interest among potential audiences. Together, these deliverables ensure that our contributions to software architecture education are effectively communicated and accessible to the intended audience, which fulfils our primary objective of enhancing educational design and practice.

3.2 Achievements

Throughout the project lifecycle, our team achieved several milestones related to our initial objectives, leading to the success of our project and appropriate risk management.

- ***Comprehensive literature review***

A comprehensive literature review has been completed, covering 82 peer-reviewed papers from various academic databases. This surpasses our initial target of 50, laying the foundations for our systematic review and interrelationship analysis.

- ***Collaborative and Iterative Report Development***

Our final report is completed based on several iterations of the draft report, reflecting continuous improvement as a result of team reviews and sponsor feedback. This ensures that teaching strategies are well synthesised, and the final report is satisfactory to address our research question in-depth.

- ***Group collaboration and time management***

Our team work collaboratively and effectively during the whole project process. This requires advanced teamwork skills and time management. Group engagement and resilience ensure our group's capacity to address research questions effectively and resolve group conflicts efficiently. In addition, all tasks are completed based on our group schedule, leaving sufficient time for adjustments and improvement.

3.3 Quantitative or qualitative results

Our project provides several quantitative and qualitative results, demonstrating the project's success in achieving our objectives:

- ***Quantitative Results:***

- Comprehensive coverage of relevant articles: initial search of 58,027 articles from 10 academic databases, based on which 82 articles were selected for additional analysis, exceeding the original target of 50.
- 10 major teaching themes, 5 industrial-related practical skills, 4 assessment approaches, 6 levels of learning outcomes based on Bloom's Taxonomy and 13 challenges are identified. Their interrelationships are also critically analysed.
- 4 versions of draft reports are produced and refined iteratively.
- 6 deliverables are completed based on relevant requirements and on time.

- ***Qualitative Results***

- The identified ten teaching themes, their assessment approaches, and outcomes based on Bloom's Taxonomy and challenges are evaluated interactively to identify their pros and cons, based on which literature-supported recommendations are provided to address challenges to improve learning outcomes.
- Group minutes of meetings are well maintained, demonstrating a high level of group collaboration and engagement.
- Feedback from sponsors and mentors is carefully considered and incorporated during the iterations of the project.

3.4 Alignment with KPIs

At the beginning of our project, the following Key Performance Indicators (KPIs) were established to guide project success. Our final outcomes demonstrate strong alignment with these KPIs, as outlined in *Table 1* below:

Table 1: KPIs and their Achievement

KPI	Target	Performance
Number of articles reviewed	Review at least 50 peer-reviewed articles from 2010–2024	Achieved: 82 articles reviewed
Academic database used	Use multiple highly relevant academic databases (min. 5)	Achieved: 10 highly relevant databases are used
Address 5 RQs	Address all 5 research questions with academic support	Achieved: all 5 RQs are addressed academically
Complete deliverables	Submit all 6 deliverables before deadlines and meet quality standards	Achieved: all 6 deliverables are completed based on requirements and with high quality.
Synthesis teaching themes	Identify and categorise non-overlapping teaching themes with academic support	Achieved: 10 major teaching themes synthesised
Synthesis practical skills	Identify practical skills demanded by industry and discussed in reviewed articles	Achieved: 5 practical skills integrated and aligned with industry expectations
Synthesis assessment approaches	Identify thematic concepts in assessing teaching themes and synthesis	Achieved: four particular thematic concepts are identified and summarised
Evaluate learning outcomes	Identify a framework to evaluate outcomes	Achieved: Bloom's Taxonomy is adopted for evaluation
Synthesis challenges	Identify and categorise non-overlapping teaching themes with academic support	Achieved: 13 major challenges synthesised
Teamwork Effectiveness	Maintain regular meetings and ensure equitable contribution from all team members	Achieved: Weekly meetings held; all members contributed to all deliverables
Teamwork collaboration	Adopt shared platforms (OneDrive), use instant messaging (WhatsApp), and maintain a response time within 24 hours.	Achieved: Shared drive used for collaboration; instant messaging platforms actively used; responses typically within 1 hour.
Time Management	Complete all milestones 1+ days before deadlines to allow review time	Achieved: All key drafts are finalised at least 2 days before the due date, and final reviews are conducted on the final day.
Sponsor Engagement	Hold at least 6 formal meetings and incorporate sponsor feedback	Achieved: Sponsor meetings held; feedback integrated into final outputs

Accordingly, all these KPIs are achieved during our 13-week project. These KPIs are closely related to our preliminary project aims because they track and measure the whole research process to ensure our final deliverables are with high-quality and completed on time. For example, the achievement of the number of peer-reviewed papers ensures we collect sufficient high-quality data for our report, laying a foundation for further analysis and evaluations. Teamwork effectiveness and collaboration are used to measure the quality of our teamwork, which is the basis for team synergies to be achieved (Hertel 2011). In addition, Time management is essential to ensure all our deliverables are completed before their deadlines. Without these measurements on KPIs, our team cannot know what we have achieved and how well we performed.

3.5 Quality Assurance Measures:

Our team produces Quality Assurance criteria and measures for our whole project and deliverable-specific quality standards. These criteria and measures are shown in the Appendix. Table 2 and

Table 3 illustrate whether the success indicators are achieved.

Table 2: Achievement of success indicators

Criteria	Success Indicator	If achieved?
a. Consistency and Methodological Reliability	A detailed methodology section in the final report	Achieved
b. Comprehensiveness of Literature Search	A comprehensive search strategy that covers major databases	Achieved
c. Depth of Analysis and Synthesis	A well-structured synthesis section in the final report provides meaningful insights into software architecture teaching.	Achieved
d. Impact and Relevance	A discussion section that highlights the practical implications of the findings and suggests specific areas for future research.	Achieved
e. Clarity and Presentation	Positive feedback	Achieved
f. Timeliness	Completion of all project deliverables	Achieved
g. Ethical Compliance	A clean plagiarism report	Achieved

Table 3: Achievement of Quality Standards on Project Deliverables

Project Deliverables	Quality Standards	If achieved?
Research Protocol	Clearly defined research questions and objectives.	Achieved
	Inclusion/exclusion criteria and rationale	Achieved
	Detailed search strategy, including databases, keywords, and filters.	Achieved
	Plan for data extraction and synthesis.	Achieved
Literature Search Results	Comprehensive list of studies identified through the search process.	Achieved
	Documentation of any deviations from the original search strategy.	Achieved
Data Extraction and Quality Assessment	Completed data extraction forms for all included studies.	Achieved
	Summary table of study characteristics (e.g., author, year, methodology, key findings).	Achieved
Synthesis and Analysis	Thematic analysis or meta-synthesis of the findings.	Achieved
	Identification of key themes, patterns, and gaps in the literature.	Achieved
	Visual aids (e.g., tables, charts) to support the analysis.	Achieved
Final Report	Clear and concise executive summary.	Achieved
	Well-structured report with specific sections and sub-sections.	Achieved
	Discussion of limitations and implications for future research.	Achieved
	Well-formatted references and appendices.	Achieved

The review of measures of success for both the whole project and specific deliverables shows that all our success factors have been achieved. This is justifiable because our final report, presentation and poster include the relevant sections articulated in the success factors and quality standard.

3.6 Impact of the project

This project has a significant impact on multiple stakeholders in the field of software architecture (SA) education, particularly educators, curriculum designers, and students. By synthesising 82 peer-reviewed studies published between 2010 and 2024, this study identifies ten major teaching themes and analyses their alignment with industrial expectations, challenges of implementation and learning outcomes using Bloom’s taxonomy.

Distinguished from previous mapping studies, this research examines the interactive relationships among teaching strategies, assessment practices, educational outcomes, and relevant challenges. This provides a more comprehensive understanding of SA education. In

addition, by analysing from the student perspective, the study offers new insights into how SA education can equip students with sufficient skills for industry needs. These two issues bridge the research gaps not addressed by prior research, which enhances contributions to SA education academically.

Our study also offers practical impacts on multiple stakeholders. For practitioners, this review offers clear guidance on which teaching themes are most effective in delivering hands-on, industry-aligned learning. For curriculum designers, it delivers evidence-based recommendations for curriculum improvement. For educational institutions, it offers insights into instructor training needs, as well as how teaching staff can be well-equipped to implement effective teaching strategies. Overall, this study supports a deeper understanding of effective SA teaching practices and recommends actionable strategies to address challenges faced by students and instructors.

4. Report on Resources.

The success of this project relied on both human and digital resources. In this section, we outline the estimated time each team member contributed over the 13-week project period and the tools and technologies employed to support the systematic literature review.

4.1 Human Resources

For this project, our group collectively contributed a total of 1,075 hours, with each member investing approximately 215 hours. This project proved to be particularly intensive, as it involved exploring a completely new domain for all of us. We actively engaged in all stages of the research, including literature searches, data extraction, thematic synthesis, and the drafting of the final report. The total contribution time reflects each team member's average weekly commitment and task distribution, as detailed in Table 4.

Table 4: Average hours contributed by each team member

Task Description	No. of Hrs				
	PG	TD	TR	UL	ZR
Selection of research topic and doing a background study	15	15	15	25	10
Identification of research methodology	15	25	20	15	10
Development of search strategy and literature search	20	20	20	10	20
Data collection and organisation	20	15	15	15	20
Literature review	45	45	45	45	45
Extraction of findings	20	20	20	20	25
Data synthesis	30	30	30	30	30
Drafting of the report	30	30	30	40	40
Poster preparation	20	15	20	15	15
Total	215	215	215	215	215

4.2 Tools and Technologies

The following tools were utilised throughout the process:

i. Academic Databases

- We explored IEEE Xplore, ACM Digital Library, Scopus, SpringerLink, and ScienceDirect for peer-reviewed articles that met our inclusion criteria.

ii. Communication and Collaboration

- Microsoft Teams & Outlook: Utilised for weekly progress meetings, task assignments, and official correspondence.
- WhatsApp: Enabled ongoing communication and daily updates among team members.
- SharePoint & Microsoft OneDrive: Centralised storage with collaborative editing features and easy file sharing.

iii. Writing and Referencing

- Microsoft Word: Employed to draft the report in an academic format.
- EndNote: Utilised to manage references and format citations.

iv. Analysis and Data Management

- Microsoft Excel: Processed data extraction tables, analysis records, thematic matrices, and article coding.
- Covidence: For the inclusion and exclusion of review papers and screening documents. This tool visually represents the screening and selection process.

v. Project Management

- MS Project Professional: Implemented for setting timelines, tracking milestones, and viewing project dependencies.

Together, these tools enabled effective communication, improved document management, accurate referencing, and strict adherence to methodological rigour.

5. Report on outstanding issues.

The project was completed on time with no outstanding issues. However, the team encountered challenges in developing the analysis and maintaining a student-centric perspective throughout the discussion. A primary conceptual challenge was merging key findings into a unified narrative from the learners' viewpoint across different teaching methods. The team also faced tremendous challenges in completing the project in a 13-week timeline given that we had to navigate the project from planning to article review, analysis, synthesis, and writing. As a result, certain phases of work, such as literature review and project synthesis were conducted under considerable time constraints, especially as the deadline approached. Nonetheless, these challenges were gradually addressed through iterative development, team collaboration and guidance from the sponsor and mentor.

6. Report of risk mitigated.

Table 5: Risk Management Results

Risk identified	Mitigated Strategy	Result/Outcome
Duplication of review articles	We gathered all the data in a shared sheet, enabling everyone to check for duplicates. Furthermore, we used Covidence to stay organised and notify us of duplications while replacing overlapping articles with new, relevant studies.	The duplication was resolved quickly, ensuring that project timelines and team efforts remained unaffected. A varied and non-redundant dataset was preserved.
Limited access to the key database	By using the University of Canberra's institutional subscriptions to access those databases.	Full access to vital academic resources was obtained, allowing for comprehensive and representative literature reviews.
Challenges in synthesising diverse teaching methodologies	Use thematic analysis to group similar methodologies. Establish clear criteria for categorising and comparing different strategies. Engage a sponsor to validate synthesis approaches.	Ten themes were identified for the teaching strategies and categorised with clear and comprehensible concepts.
Data Management and Organisation Challenges	Regularly back up data in secure cloud storage or institutional repositories.	All documents were stored in a single SharePoint for easy access and were well-maintained.
Scope Creep	The inclusion and exclusion criteria were established rigorously beforehand. Any ambiguous cases were collaboratively reviewed and discussed with the sponsor.	This study mainly concentrated on teaching software architecture, ensuring thematic consistency.
Time Constraints	Initiated weekly progress meetings and set internal deadlines for individual tasks, adjusting responsibilities as required.	The key project activities were finished on schedule, enabling a partial internal review before completion.
Communication Breakdown	Set up reliable communication channels (Microsoft Teams, WhatsApp); conduct daily check-ins during critical moments and escalate unresolved issues.	Communication effectiveness was substantially enhanced, allowing problems to be more easily dealt with promptly and keeping the project on track.

7. Report of lessons learned

This systematic literature review on teaching software architecture has yielded several crucial insights regarding research methodology, collaboration, project organisation, and ethical practices.

One important observation during this process was recognising the need to develop a robust analytical and academic reading approach. This included reviewing articles and situating the findings within each research question. Team members' poor familiarity with such skills often led to having to read articles repeatedly, which was time-consuming and impractical given the limited timeframe of 13 weeks. This experience taught us the importance of proactively preparing and staying ahead. Progress depended on the depth of the literature review and the ability to articulate ideas effectively and swiftly in the progressing paper. The ability to analyse, synthesise, and communicate emerged as essential for maintaining project momentum and enabling effective teamwork. The project has taught us that success in systematic study is not only about academic ability, but also about discipline and the influence of peer dynamics.

Team coordination was another key lesson. Regular internal meetings, clearly defined tasks, and collaborative tools effectively kept the project on schedule, especially during the high-pressure final stages leading to submission deadlines. Open communication and peer-review processes within the team enhanced the quality and coherence of the outputs.

The team's significant ethical issue involved members' accidental duplication of reviewed papers during the initial article selection phase. This posed a concern for academic integrity and equitable distribution of analytical responsibilities. Once identified, the matter was addressed openly through team discussions, leading to the replacement of the duplicated papers with new, eligible studies. This response showcased values of collaboration, accountability, and honesty within academic research.

Reflections: What Went Well

- Methodological rigour: A predefined, structured systematic review facilitated clarity and consistency throughout the project stages.
- Team resilience: The team's exceptional capacity for collective problem-solving was especially evident in tackling scope or thematic issues and ambiguities.
- Sponsor involvement: Regular meetings with the sponsor were beneficial for external validation and enhanced the project's academic integrity.

Reflections: What Could Be Done Better

- Proactive cross-validation of article lists: A more organised cross-checking of content at an earlier phase could have prevented the initial duplication problem.
- Time allocated for synthesis: Allocating more time for in-depth discussions about the categories might have improved the theoretical richness and depth of the analysis.
- Version control protocols: Establishing stricter version control for draft documents and thematic matrices could have increased transparency and improved collaborative writing efficiency.

In conclusion, the project advanced our academic skills, technical expertise, and ethical viewpoints, emphasising the significance of structured teamwork, methodological rigour, and ethical awareness in research.

8. Handover materials

Handed over the following document upon completion of the project.

- i. Final Project Report
- ii. GitHub Repository “Capstone Project S1-38” consisting of these folders.
 - Meeting Minutes
 - Project Proposal
 - Research Project
 - Research Report

9. Recommendations to sponsor

The project team expresses gratitude for the sponsor’s unwavering support, insightful guidance, and consistent availability throughout the progression of the project. The sponsor’s eagerness to communicate, meeting attendance, and openness to requests significantly enhanced the team’s confidence and academic development. The team currently does not have any suggested changes. The sponsor’s presence, promotion, and academic insight proved to be highly productive. We advise maintaining the same level of support and involvement that contributed to our positive experience with the team.

10. Opportunities for Future Development

This work lays the foundation for further exploration of pedagogical techniques in teaching software architecture. Several potential extensions or broader educational and practical applications can emerge from this work:

i. Mixed-Method Approach

The current study relied solely on secondary data and conducted a systematic literature review, indicating a future research opportunity utilising mixed methods. Collecting primary data through student and teacher interviews, focus groups, or questionnaires would enhance our understanding of how individual teaching strategies are perceived and enacted in practice. This could triangulate literature findings with firsthand classroom experiences.

ii. Longitudinal Study on Findings

Thematic categories and strategies identified in the literature review should align with specific course learning objectives in actual software architecture modules. Conducting a curriculum alignment study would assist educators in identifying discrepancies between what is taught and existing knowledge on effective instruction. Additionally, implementing a subset of these strategies in a real course could facilitate longitudinal assessments of their impact on student learning.

iii. Creation of Educator Support Tools

The findings of this review may guide the development of practical tools for educators, including decision-making support tools, lesson plan checklists, and digital resource banks. Such resources would alleviate educators' challenges in selecting the most appropriate teaching methods for their institutions, student demographics, and specific pedagogical goals. For instance, creating tools to integrate architectural kata into the assessment framework can aid in lesson planning and instructional practices. Overall, these supportive mechanisms would help bridge the gap between research and classroom application, enhancing the efficacy and utility of evidence-based practices.

iv. Cross-Disciplinary Studies on a Global Scale

Future research endeavours may consider replicating such systematic reviews or empirical studies across diverse academic institutions and cultural contexts. A comparative analysis of methodologies utilised in various locations or educational systems would yield more generalisable findings and provide greater insights into how contextual factors, such as institutional policies, cultural expectations, and resource availability, influence the effectiveness of education regarding software architecture. In this regard, these interdisciplinary, international studies could serve as a foundation for developing universal teaching formats that can be implemented globally.

11. Conclusion

This project successfully conducted a systematic review of software architecture (SA) teaching, with a primary focus on hands-on practical experiences, assessment methods, learning outcomes, and associated challenges. The research identified ten key teaching themes, with a strong emphasis on student-centred strategies. Project-Based Learning (PBL) emerged as the most widely adopted approach, followed by Real-World Based Learning and Collaborative Learning all of which closely align with industry needs by fostering practical skills, critical thinking, and teamwork.

Most teaching strategies were found to support higher-order learning outcomes, particularly at the “Understand” and “Apply” levels of Bloom’s taxonomy. However, the limited emphasis on the “Create” and “Evaluate” levels indicates a need for further innovation in teaching methodologies. While summative assessments remain prevalent, the study recommends greater use of experiential assessment tools, such as Architectural Kata, to more effectively evaluate both technical competencies and transferable skills.

Key challenges were also identified, including abstract and conceptual difficulties, workload pressures, and engagement issues for students. Educators, in turn, face high workloads, limited practical experience, and resource constraints. Overcoming these challenges requires stronger collaboration among stakeholders, the adoption of diverse and adaptive teaching strategies, enhanced experiential learning opportunities, and the integration of innovative assessment methods.

In conclusion, this project highlights the growing dominance of industry-relevant, student-centred pedagogies in SA education and offers valuable insights for aligning academic practices with real-world industry expectations. Future research is recommended to explore Agile-based learning and longitudinal studies to further enhance the effectiveness and relevance of SA teaching.

12. References

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13. Appendix

Table 9.1 in our proposal

Criteria	Measure	Success Indicator
a. Consistency and Methodological Reliability	Adherence to Kitchenham's principle and SPIDER framework.	A detailed methodology section in the final report, a clear explanation of the search strategy, inclusion/exclusion criteria, and data extraction process.
b. Comprehensiveness of Literature Search	Number of databases searched, studies identified, and studies included in the review.	A comprehensive search strategy that covers major databases and results in a sufficient number of high-quality studies for analysis.
c. Depth of Analysis and Synthesis	Use of thematic analysis or meta-synthesis to identify key themes, patterns, and gaps in the literature.	A well-structured synthesis section in the final report that provides meaningful insights into software architecture teaching practices, challenges, and innovations.
d. Impact and Relevance	Number of actionable recommendations provided for educators, learners and researchers.	A discussion section that highlights the practical implications of the findings and suggests specific areas for future research.
e. Clarity and Presentation	Feedback from peer reviewers or stakeholders on the clarity and organization of the report.	Positive feedback indicating that the report is well-written, easy to understand, and effectively communicates the findings.
f. Timeliness	Adherence to the project deadlines and milestones.	Completion of all project deliverables within the agreed timeframe.
g. Ethical Compliance	Proper citation of all resources used for the research project.	A clean plagiarism report (e.g., using Turnitin or similar software) and a properly formatted reference list.

Table 9.2 in our proposal

Project Deliverables	Quality Standards
Research Protocol	<ul style="list-style-type: none"> • Clearly defined research questions and objectives. • Detailed search strategy, including databases, keywords, and filters. • Inclusion/exclusion criteria and rationale. • Plan for data extraction and synthesis.
Literature Search Results	<ul style="list-style-type: none"> • Comprehensive list of studies identified through the search process. • Documentation of any deviations from the original search strategy.
Data Extraction and Quality Assessment	<ul style="list-style-type: none"> • Completed data extraction forms for all included studies. • Summary table of study characteristics (e.g., author, year, methodology, key findings). • Quality assessment scores for each study.
Synthesis and Analysis	<ul style="list-style-type: none"> • Thematic analysis or meta-synthesis of the findings. • Identification of key themes, patterns, and gaps in the literature. • Visual aids (e.g., tables, charts) to support the analysis.
Final Report	<ul style="list-style-type: none"> • Clear and concise executive summary. • Well-structured report with specific sections and sub-sections. • Discussion of limitations and implications for future research. • Well formatted references and appendices.