Improving Students Wellbeing, Resilience and Employability Skills in Capstone Projects - Highlights of Good Practice

Saad, Rola[a] He, Ya[b]

Department of Electronic and Electrical Engineering, The University of Sheffield, UK[a]
Department of Chemical Engineering, The University of Sheffield, UK[b]

Corresponding Author's Email: r.saad@sheffield.ac.uk

KEY WORDS: Capstone projects, employability, resilience, teamwork, wellbeing

SUMMARY

In recent years, there has been a significant shift towards providing comprehensive support to university students for their professional development, transferable skills, and employability. Capstone projects play a pivotal role in bridging the gap between academic learning and practical application, equipping students to navigate the challenges of their future careers (Fung, 2017) . These projects often serve as a reflection of students' growth and development, with successful completion signifying the acquisition of essential skills and knowledge in their chosen field of study.

This engineering education practice paper explores the latest developments in engineering capstone project coordination, tutoring, and assessment, with a specific focus on enhancing student wellbeing. These practices aim to equip students with greater resilience, improved employability, and stronger teamwork skills, essential in the dynamic and diverse field of engineering. The intervention showcased here represents a significant enhancement for the 2022-2023 academic year in reinforcing the structure of capstone projects within the Department of Electronic and Electrical Engineering at The University of Sheffield. Initial findings indicate improvements in student wellbeing and interpersonal skills due to well-structured tutoring support and clear module deliverables guidelines.

INTRODUCTION

Capstone projects serve as comprehensive assessments that gauge undergraduate students' cumulative knowledge and skills (Sobek and Jain, 2004). They offer a practical context for applying theoretical knowledge to real-world issues, enhancing technical expertise (Burke, Dempsey, 2021). Additionally, the collaborative aspect of capstone projects nurtures essential interpersonal skills, including teamwork, communication, and conflict resolution, which are particularly valuable in the engineering field (Zheng, Zhang, and Li, 2015; Paretti et al., 2013). As students confront multifaceted challenges and extensive practical work, resilience becomes a critical factor in their success.

Understanding Students' Resilience in Capstone Projects

In academia, resilience generally refers to the student's capacity to maintain focus and motivation amid challenges (Ye, Strietholt, and Blömeke, 2021), such as those encountered in capstone projects (Greeff et al., 2021). Numerous studies view resilience as not just the ability to bounce back from setbacks but also to foster personal growth and learning during adversity (Jardim et al., 2021; Stephens, 2013; Fu et al., 2021).

Capstone projects, with their complexity and deadline pressures, often induce significant stress and anxiety in students (McGill, 2012). They require intellectual prowess, meticulous planning, time management, and emotional regulation, potentially impacting mental health negatively if not handled well. However, research by Mokhtar (2010) and Ritenour et al. (2020) demonstrates that supportive mentorship and peer collaboration can enhance resilience and employability. This results from shared knowledge and collaborative problem-solving that alleviates project pressures. Therefore, understanding resilience in capstone projects is vital for educators, providing insights into student well-being and suggesting interventions to support their academic journey.

Academic Anxiety: Teamwork Pressure, Deadlines and Workloads

Academic anxiety, characterised by excessive concern regarding academic tasks and experiences (Hooda and Saini, 2017), is known to detrimentally impact student wellbeing and academic performance (Chambel and Curral, 2005). Within the context of capstone projects, anxiety varies based on interactions, experiences, and expected outcomes, influencing students' emotional development (Parker, 2017). Hence, fostering resilience becomes vital in capstone projects.

Contemporary students face a multitude of challenges, including teamwork pressure, looming deadlines, and heavy workloads. Research by Dafogianni et al. (2022) establishes a connection

between resilience and students' stress and anxiety levels, particularly during the COVID-19 pandemic. This suggests that students with lower resilience may be more susceptible to academic anxiety. Additionally, academic stress has been linked to decreased psychological wellbeing (Barbayannis et al., 2022). The emphasis on collaborative work has also introduced academic stressors, with interpersonal conflicts and communication barriers intensifying anxiety levels (Zheng et al., 2023). Yangdon et al. (2021) study reveals that students often find large assignments and tight deadlines overwhelming, fostering feelings of helplessness and procrastination. Therefore, the combination of teamwork pressures, deadlines, and workloads significantly contributes to academic anxiety. Recognising and addressing these factors is crucial for tailored interventions that create a more supportive and manageable learning environment for students.

LITERATURE REVIEW

Structured Learning and Tutoring to Boost Students' Resilience and Well-being

Establishing a structured learning and tutoring system is crucial for promoting resilience and wellbeing among students. Morrison and Allen (2007) and Knight (2007) have emphasised the role of educators in enhancing students' resilience and reducing anxiety through academic and emotional support. Ganzer and Zauderer (2013) have underlined how structured learning environments can provide clarity, improving understanding and engagement while mitigating anxiety. Also, structured teaching and learning environments enhance student engagement, confidence, and classroom inclusivity (Neill et al. 2019). Complementing structured learning, structured tutoring programs, as indicated in Watts's (2011) study, not only boost academic performance but also improves students' resilience against academic challenges.

The intersection of structured learning and tutoring offers a powerful pedagogical framework for improving higher education. Their combined potential in enhancing students' resilience and wellbeing is profound, warranting further exploration and integration in contemporary educational settings.

CONTEXT: THE ENGINEERING EDUCATION PROBLEM

In the Department of Electronic and Electrical Engineering, the capstone projects are a pivotal 45-credit module within the MEng program. This module offers students a unique opportunity to collaboratively tackle real-world engineering challenges, fostering the development of

essential soft and interpersonal skills. These encompass teamwork, problem-solving, effective communication, professionalism, and a heightened awareness of environmental and engineering issues in system design and development.

Spanning six months, the project progresses through three critical stages: the initial, interim, and final phases, requiring student engagement in group meetings, peer reviews, presentations, and the submission of group reports. Nevertheless, students often encounter time management difficulties, team conflicts, and goal clarity issues, while also needing to maintain resilience and a positive attitude, as documented in studies (Zheng, Zhang, and Li, 2015; Steele, Cleland, and Engelbrecht, 2013; Baumber et al., 2021).

To address these challenges, this paper introduces an intervention to enhance the capstone project's structure and tutoring systems, equipping students to navigate complexities, improve teamwork, and problem-solving skills, ultimately ensuring a successful student project experience.

DESCRIPTION OF INTERVENTION / PRACTICE

Before this intervention, support on capstone only included a kick-off talk on objectives, milestones, project conduct, and safety. The module on Blackboard covered project information and assessment milestones requirements, and the lead communicated via email before each milestone. The project coordinator only sees the teams at the start and then when they require by appointment, so no proactive interaction on a regular basis. Students are closely supervised by two academics, ensuring the team effectively works on the project technical aspects. However, students are expected to be proactive and professional within their team, without any training, and supervisors assesses individual and team professionalism at two stages. As a result, unaddressed conflicts and struggles can impact performance and well-being of students and reduces the team efficiency. Therefore, a complete restructuring of Capstone Projects coordination and support was implemented in two distinctive angles (a) project assessments and marking criteria and (b) building resilience and enabling effective teamwork and employability skills.

For the first part of the intervention, the project deliverables are revamped to include a clear set of re-defined milestones that evaluate students' subject knowledge and interpersonal skills such as: teamwork, communication, system modelling, project management, self-awareness, critical thinking, problem solving, collaboration sustainability, and ethical awareness. Assessment of these skills were conducted in 3 phases *initialisation, interim and final*; where students engaged in writing technical group reports, peer reviews, presentations, and regular

project meetings. Throughout the process students can reflect on their progress via constructive written and verbal feedback. Students were provided with a project handbook, a detailed milestone assessment criteria and marking rubric so they can work to success and ask questions early on. Furthermore, throughout the duration of the project, technical talks and student voice sessions were conducted to explain the assessment process and address any questions or issues the team have. These sessions proved effective as students often had questions around the assessment and this was an opportunity to discuss any concerns. Furthermore, supervisors received induction on the project marking process to support students effectively.

The second part of intervention focused on building students' resilience and awareness of the skills required in the job market. Therefore, students actively participated in thoughtfully crafted in-person interactive activities aimed at upskilling students and increasing awareness around the importance of wellbeing, effective teamwork, resilience, time management, and highlights key skills recognised by employers. Interactive sessions ran throughout the project duration at key intervals when students are expected to benefit from the information the most, summarised below:

- Teamwork interactive workshop to educate students on strategies to proactive team collaboration, emphasising its importance to project success.
- Wellbeing sessions-1 conducted early in the year to emphasise the importance of wellbeing, time management, effective collaborations, and sleep hygiene.
- Wellbeing session-2 post semester 1 exam period to support students to peruse their projects and continue with effective teamwork, with key themes around managing workload and expectations.
- Alumni event where project students are invited to meet with recent graduates offering networking and employability focused activity.
- Meet the employer event in which students have direct interaction with industry to hear from recruiters about skills requirements and the job market needs. These sessions were bespoken to electronic and electrical engineering disciplines, supported by the university career services and offered our students the opportunity to reflect on their progress and plan their career from early on.

EVALUATION AND DISCUSSION OF INTERVENTION / PRACTICE

In an attempt to boost students resilience, and encounter time management difficulties, team conflicts, and goal clarity issues as reported in the literature (Zheng, Zhang, and Li, 2015; Steele, Cleland, and Engelbrecht, 2013; Baumber et al., 2021), the above intervention has been adopted. It has been observed that this structured intervention in improving clarity about assessment and transferrable skills support, students are given the opportunity to demonstrate career knowledge and showcase their career readiness skills. The intervention

detailed in the preceding section has yielded a remarkable transformation in the student experience, as indicated by their feedback and improvements in National Student Survey (NSS) scores. Students have expressed genuine appreciation for the opportunity to leverage their capstone project experiences, using them as a springboard to enhance both technical and interpersonal skills. This journey has not only boosted their self-confidence but has also broadened their perspectives on career opportunities.

The revamped tutoring structure empowered students (Tsai et al., 2020), offering them a platform to voice their opinions and promptly address any project-related issues and team dynamics, facilitating effective conflict resolution. To gauge the impact of this initiative, an informal post-session student feedback survey was conducted, which garnered overwhelmingly positive responses.

Impact of Technical Project Talks and Documentation

The purpose of conducting three technical project talks was to guide students in creating and presenting project reports systematically. This approach helped them understand report writing details and meet initial, interim, and final stage requirements effectively. Enhanced documentation guidance and marking rubrics clarified technical and teamwork expectations. According to student feedback, most find the learning objectives clear and express satisfaction with their skill and knowledge acquisition.

Impact of Wellbeing Workshop

These workshops equip students with strategies for managing their academic workload while maintaining their well-being, resulting in improved team performance. They also teach stress management and interpersonal skills, reducing burnout and conflicts within teams. The impact has been evident from clear observation of improved individual and team performance and as recorded from student's feedback who followed up post these sessions. This has proven to be crucial in improving performance and building resilience throughout the project duration (Brewer et al., 2019).

Alumni Visits Influence

Incorporating alumni visits into capstone projects tutoring system is instrumental in bridging the gap between academic theory and real-world applications. These visits offer students a firsthand glimpse into current industry developments and requirements, enabling them to make informed decisions about their early career paths. Interactions with alumni provide students with tangible connections to the professional world as they transition from academia to the workforce, thereby helping them map out clearer career trajectories. An informal survey revealed that students deeply appreciated this valuable opportunity.

Impact of Employability Sessions

The two dedicated employability sessions played a pivotal role in guiding students towards shaping their post-graduation aspirations. Students were provided with a unique opportunity to glean insights into the paramount significance of interpersonal skills in the workplace, directly from industry experts.

Moreover, the practical sessions empowered students to not only recognize their skill gaps but also appreciate the critical role of resilience, effective communication, and collaboration, all of which were evident through their improved teamwork (Scott et al., 2019, Keller et al., 2011). Post-session survey results affirmed that students derived substantial value from these sessions, enhancing their awareness of the pivotal role of skill development in elevating their employability profiles.

CONCLUSIONS & RECOMMENDATIONS

For this intervention, it has become evident that there's a pressing need to engage students with wellbeing awareness and provide a structured approach to educate students on the importance of effective teamwork to the success of project delivery. This is the responsibilities of educators and students (Moe et al., 2010). The initiatives highlighted, from technical project guidance to employability sessions, underscore a comprehensive approach to enriching the university student experience. The project delivery has also demonstrated that offering clear project milestones, emphasising wellbeing, fostering industry connections through alumni interactions, and improving employability skills address both the academic and personal development needs of students. By building a multifaceted approach, students can learn and practise on campus to become not only technically proficient but also emotionally resilient, well-connected, and prepared to succeed in the post-academic world. Additionally, it is evident from the post-course feedback surveys that students value teamwork and employability training. Such training not only prepares students for their future careers but also creates an inclusive learning environment and enhances their overall learning experience.

It is, therefore, important for institutions to prioritise and sustain the efforts to develop these training projects more and better.

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