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The challenges of implementing Course-Based Undergraduate Research Experiences (CURE) in Hong Kong universities for healthcare-related professional students

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Abstract

This study aims to explore the challenges and implications of implementing Course-based Undergraduate Research Experiences (CURE) in biomedical science and healthcare-related programs at universities in Hong Kong. The main results reveal that resource constraints, time limitations, and traditional assessment methods pose significant challenges in the integration of CURE. The study emphasizes the importance of developing tailored assessment strategies to effectively capture the multifaceted skills and competencies developed through research experiences. Additionally, creating a supportive learning environment that encourages student input and involvement in experimental design is crucial. The findings highlight the need for strong teacher-student partnerships to foster collaboration, enhance students' critical thinking skills, and promote their overall academic and professional development. In conclusion, addressing these challenges and incorporating best practices in CURE implementation can better prepare students for real-world research and promote their holistic growth.

Keywords: *Course-based Undergraduate Research Experiences (CURE); Biomedical science and Healthcare-related programs, Teaching laboratories Challenges, Assessment strategies; Teacher-student partnerships.*

1. Introduction

There has been a growing interest in incorporating Course-Based Undergraduate Research Experiences (CURE) into higher education curricula (Calède, 2023). Previous studies have

highlighted the benefits of CURE, such as enhancing critical thinking, problem-solving skills, and bridging the gap between theory and practice (Bangera & Brownell, 2014; Shortlidge et al., 2016).

In Hong Kong, the availability of well-paying jobs for most healthcare professional students after completing their undergraduate studies may discourage them from pursuing postgraduate education and research. As a result, there is a limited pool of qualified individuals who choose to become teachers in the healthcare field, leading to a long-term shortage of instructors. This issue underscores the importance of exploring the opportunities and challenges associated with implementing CURE in tertiary institutions in Hong Kong, particularly for healthcare-related programs. By understanding the specific obstacles faced by teachers and students in this context, appropriate interventions can be developed to address the shortage of teachers and promote the integration of research experiences into the curriculum.

Two years ago, we conducted a preliminary study at one of the Hong Kong universities, which revealed that CURE stimulate the interest of healthcare professional students in pursuing postgraduate studies, thereby addressing the shortage of healthcare professional teachers(Yau et al., 2022). However, the specific challenges faced by teachers in implementing CURE in tertiary institutions in Hong Kong, particularly for healthcare-related students, have not been extensively explored. Consequently, this follow-up study aims to investigate the opportunities and challenges associated with implementing CURE in this context. To gather data, questionnaires and interviews were administered to teachers, enabling an exploration of their experiences and difficulties in implementing CURE within Hong Kong universities, with a focus on biomedical science and healthcare-related programs. Additionally, a follow-up study involved distributing questionnaires to students to validate the findings. By collecting perspectives from both teachers and students, we seek to develop a more comprehensive understanding of the opportunities and challenges associated with implementing CURE in Hong Kong universities.

2. Methods

The study encompassed a retrospective analysis of undergraduate practical teachers (n=27) and their students (n=39) enrolled in healthcare-related professional programs across four tertiary institutions in Hong Kong. To ensure the anonymity and objectivity of responses, blind questionnaires were developed and administered to both teachers and students through MS Form. This data collection approach aimed to gather quantitative data on teaching approaches and practical experiments. Additionally, semi-structured interviews were conducted with teaching staff from healthcare-related programs to obtain qualitative insights into the challenges faced during the implementation of CURE. Descriptive statistics were utilized to analyze the quantitative data, while thematic analysis was applied to the qualitative data. By incorporating

these methods, the study intended to gain a comprehensive understanding of the practical application of teaching approaches, the effectiveness of various tools, and the obstacles encountered in facilitating hands-on learning experiences in healthcare education.

3. Results

According to the teacher survey, approximately 48% of practical sections followed step-by-step protocol approaches, with varying levels of detailed instructions. Additionally, around 33% of practical sections were based on teacher demonstration. These findings suggest that a significant proportion of teaching laboratories still rely on traditional approaches, limiting hands-on experience for students.

Building upon the findings from the teacher questionnaires, the student questionnaires provided further insights into the challenges faced by students in their practical experiences. It was revealed that approximately 43% of teaching laboratories still rely on classical approaches, where students are expected to follow step-by-step protocols to obtain the expected results. Moreover, the student survey indicated that only about 25% of practical sections involve hands-on experience, often through teacher demonstrations. This lack of hands-on experience was identified as a significant issue by the students.

Table 1. Description of teaching style during practical sections as reported by teachers and students.

Response by	Teacher	Student
Step-by-step Protocol: Teachers provide students with a detailed procedure or protocol to follow, emphasizing precise instructions and sequential steps to ensure accuracy and reproducibility.	48%	43%
Demonstration-based: Teachers demonstrate the practical procedure themselves, explaining each step and highlighting key concepts and techniques while students observe and take notes	33%	25%
Inquiry-based: Teachers encourage students to explore and discover knowledge through hands-on experimentation, allowing them to generate their own questions, hypotheses, and experimental designs.	3%	17%
Problem-solving Approach: Teachers present students with real-world scenarios or challenges, guiding them to apply their knowledge and skills to find solutions and make informed decisions.	7%	10%
Others	7%	2%

Interestingly, the data revealed a discrepancy between teachers' perception of providing detailed manuals and students' perception of receiving detailed instructions. Most teachers believed they provided very detailed instruction, but most of their students agreed only Moderately detailed instructions were provided. Nevertheless, 71% of the students agreed that the level of detail

provided in the instructions or protocols was just right and helpful. Only 15% of them felt it was not detailed enough and preferred more guidance, while 12% reported it was too detailed and restrictive.

Table 2. Description of the level of details provided in the instructions or protocols as reported by teachers and Students.

Response by	Teacher	Student
Very detailed instructions	51%	35%
Moderately detailed instructions	33%	53%
Brief outline-style instructions	14%	7%
Others	0%	2%

The student questionnaires also highlighted concerns about proposing alternative approaches or thinking creatively during experiments, as students feared it might lead to deductions in their marks. However, approximately 55% of students reported that their teachers would consider their input and give them credit if they provided explanations for unexpected results. This indicates an opportunity for incorporating more flexibility and student involvement in experimental design and execution.

Regarding assessment, the teacher survey indicated that about 23% of teachers graded assignments based on students' proficiency in obtaining expected results, while approximately 64% graded assignments based on their ability to interpret and explain the results. This finding suggests that the emphasis is placed on comprehending the underlying principles and effectively communicating the outcomes, rather than solely achieving predetermined results. It is encouraging to note that students also provided similar feedback, reinforcing the importance of understanding and articulating the significance of their findings.

Table 3. Description of the performance in practical sections as assessed or graded by teachers and students.

Response by	Teacher	Student
Based on their ability to obtain the expected results	23%	25%
Based on their ability to explain their results, even if they did not achieve the expected outcome	64%	55%
Based on their performance in tests or exams	8%	17%
Others	2%	1%

In addition to the questionnaires, interviews conducted with teaching staff provided further insights into the challenges of implementing CURE. Firstly, there is a lack of resources and infrastructure required for successful implementation, including laboratory facilities,

equipment, and funding. This resource constraint poses a significant barrier to the widespread adoption of CURE initiatives, particularly in resource-limited settings.

Secondly, time constraints and the demands of the curriculum present challenges in integrating CURE into existing programs. Healthcare-related professional programs often have dense curricula, leaving limited space for additional research experiences. Therefore, careful curriculum mapping and coordination are necessary to ensure that students can effectively balance their academic workload while participating in research activities.

Lastly, assessing and evaluating student learning outcomes within the context of CURE can be challenging. Thus, it is crucial to develop appropriate assessment tools and strategies tailored to evaluate student learning in CURE, allowing for a comprehensive assessment of the impact of these experiences.

4. Discussion

In addition to the challenges of limited resources and time constraints, assessment, and evaluation of student learning outcomes in the context of CURE pose significant challenges (Kleinschmit et al., 2023). Conventional evaluation approaches may not comprehensively encompass the diverse range of abilities and proficiencies cultivated through research encounters. (Tai et al., 2023). This highlights the need for developing appropriate assessment tools and strategies tailored to evaluate student learning in the context of CURE. By implementing comprehensive assessment approaches, educators can more accurately measure the impact of CURE experiences on student learning and growth.

Furthermore, creating a supportive learning environment that encourages student input and creativity is crucial for the successful implementation of CURE (Goodwin et al., 2022). The findings indicate that students have concerns about proposing alternative approaches for fear of mark deductions. However, a significant majority reported that their teachers would consider their input and give them credit for explanations of unexpected results. This suggests that there is potential for incorporating more flexibility and student involvement in experimental design and execution. By fostering a supportive and inclusive learning environment, educators can empower students to think critically, propose innovative solutions, and actively engage in the research process (Golden, 2023).

The findings of the study emphasize the significance of cultivating strong partnerships between teachers and students. Collaborative and open communication between educators and learners can establish a supportive learning environment that fosters active engagement, nurtures creativity, and promotes mutual respect (Könings et al., 2021). By forging strong teacher-student partnerships, teachers can gain a deeper understanding of their students' needs, provide effective guidance and mentorship, and foster a sense of ownership and responsibility for the learning process. Valuing student input, encouraging their ideas, and involving them in

meaningful participation within the practical sections, teachers empower students and facilitate their active involvement in experimental design and execution. By incorporating students' perspectives and involving them in decision-making processes, teachers not only cultivate a sense of ownership but also enhance students' comprehension of scientific concepts and methodologies (Geurts et al., 2024). This collaborative approach enhances critical thinking skills, problem-solving abilities, and contributes to students' overall academic and professional development. Importantly, these positive changes can be implemented without significantly altering the current educational settings.

Furthermore, fostering teacher-student partnerships contributes to a more holistic assessment of student learning outcomes. By establishing regular feedback loops and constructive dialogues, educators gain valuable insights into students' progress, challenges, and areas for improvement (Carless, 2019). This feedback informs the development of tailored assessment tools and strategies that effectively capture the multifaceted skills and competencies developed through research experiences. By incorporating diverse perspectives and engaging in ongoing communication, teachers can ensure a comprehensive evaluation of student learning outcomes while providing targeted support and guidance to facilitate continuous growth and development.

However, it is important to acknowledge that this study has certain limitations. Firstly, the sample size was relatively small, consisting of a specific group of students and teaching staff from healthcare-related programs in Hong Kong. Therefore, the findings may not be generalizable to other contexts or disciplines. Additionally, the study focused on self-reported data obtained through questionnaires and interviews, which may be subject to response bias. Future research with larger and more diverse samples is needed to further explore the effectiveness and generalizability of CURE implementation in different educational settings.

In addition to addressing the shortage of healthcare professional teachers at Hong Kong, we believe the implementation of CURE can also contribute to the advancement of medical research and innovation. By actively engaging students in research projects, universities can create a pipeline of talented individuals who are equipped with the necessary skills to pursue postgraduate studies and contribute to groundbreaking research in the healthcare field. This may lead to the development of new treatments, diagnostic tools, and healthcare technologies, ultimately benefiting patient care and improving overall healthcare outcomes.

It is important to acknowledge that implementing CURE does require time and effort. However, once a culture and system of collaboration are institutionalized, remarkable results can emerge. By creating an environment that encourages and supports collaboration, universities can foster a culture of innovation and excellence, leading to significant advancements in healthcare research and practice. The benefits of this collaborative approach outweigh the initial investment, as it propels the field forward and nurtures the next generation of healthcare professionals and researchers.

5. Conclusion

In conclusion, addressing the challenges of limited resources, time constraints, and assessment strategies is crucial for successfully integrating CURE into educational programs. Additionally, promoting a supportive learning environment and fostering strong teacher-student partnerships are essential for enhancing the educational impact of CURE initiatives. By incorporating these principles, educators can effectively prepare students for real-world research, promote their overall academic and professional development, and ensure a meaningful and transformative learning experience. Tailored assessment tools and strategies can accurately evaluate student learning in CURE by capturing the multifaceted skills developed through research experiences. Creating a supportive environment that values student input and encourages critical thinking fosters their understanding of scientific concepts and overall growth. Strong teacher-student partnerships enable collaboration and active student participation in the research process, facilitating successful CURE implementation. By addressing challenges and following these principles, CURE programs equip students for real-world research, contribute to medical advancements, and foster interdisciplinary collaboration. Ultimately, these initiatives provide students with a transformative educational experience that enhances their academic and professional journey.

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