Laidlaw Scholars Report

on

Gamified interprofessional medical education: A systematic review and psychological analysis

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Abstract

In the summer of 2024, I engaged in medical education research under the supervision of Prof. Ganotice. The project title was Game On: Unlocking the power of gamified interprofessional education for knowledge co-construction (gIPE for KCC), and my task was to work on a systematic review titled: Gamified interprofessional medical education: A systematic review and neuropsychological analysis. This review summarizes current studies on the use of gamification in interprofessional medical education and provides an analysis on the psychological and neuroscientific backings of game elements involved. Throughout my learning experience, I have been provided guidance on how to conduct systematic reviews, detailed feedback on my performance, and personalized suggestions to further polish my study. This report provides an overview of my learning experience, project details, impact and future directions.

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Introduction

Under the support of the Laidlaw Undergraduate Research and Leadership Scholarship, I embarked on a three-week learning experience under the supervision of Prof. Fraide A. Ganotice in the summer of 2024. The project I participated in was Game On: Unlocking the power of gamified interprofessional education for knowledge co-construction (gIPE for KCC), and my task was to work on a systematic review on gamification and interprofessional education to be published later. After an initial literature search, and considering my background in psychology and neuroscience, I came up with a review titled: Gamified interprofessional medical education: A systematic review and neuropsychological analysis.

The review investigates two main concepts in education. Gamification and interprofessional education. Interprofessional education refers to the interactive learning between professionals across different fields, where members of each group share and learn concepts or knowledge which may otherwise be foreign to them (van Diggele et al., 2020). Interprofessional learning also facilitates the development of interprofessional competencies involving communication and teamwork skills (Curran et al., 2010). These skills are vital in disciplines such as medicine where experts from multiple disciplines often collaborate in the professional workplace (Karam et al., 2018). Examples of this include doctors working with nurses, clinical psychologists and pharmacists (Morley et al., 2017). The enhancement of communication and teamwork skills in interprofessional settings not only allows for higher group efficiency, it also allows members from various disciplines to understand the skillsets, roles and responsibilities of each other through peer teaching (van Diggele et al., 2020).

To further enhance interprofessional learning experiences and engagement, some studies have adopted the strategy of gamification alongside interprofessional education (van Gaalen et al, 2021). Gamification in education refers to the use of game elements in learning environments to enhance engagement and learning outcomes (Majuri et al., 2018). This includes the use of escape rooms, competitions and role plays. The combination of gamification in interprofessional education, in theory, would further develop interprofessional competencies by promoting team engagement and interaction through game activities (Majuri et al., 2018). When adopted in medical education, gamified interprofessional education (gIPE) provides a great opportunity for medical students to practice working with other professions (Krishnamurthy et al., 2022) and prepares them for the highly interdisciplinary nature of healthcare service and medical research.

By conducting a systematic review on papers studying gamified interprofessional medical education, we hoped to investigate 1) the overall effect of gIPE on the attainment of learning outcomes in medical education; 2) the novelty and quality of included studies, 3) existing psychological and cognitive neuroscience studies backing the effectiveness of identified game elements in interprofessional medical education. Additional areas of investigation include whether game type and study quality could significantly predict the likelihood of significant outcomes. We hypothesize that gIPE in medical education improves interprofessional collaboration skills and facilitates the attainment of medical knowledge. We also predict that the effectiveness gIPE varies across game type and study quality. Game elements identified will be dissected in medical education contexts under an inspection of underlying psychological theories and neurological evidence.

Methodology

This systematic review is registered on the International Platform of Registered Systematic Review and Meta-analysis Protocols (INPLASY; DOI: 10.37766/inplasy2024.9.0035). The protocol first involves literature searching and that was conducted through eight established databases for medicine, psychology and education. We decided on a set of keywords related to interprofessional education, gamification, medical education, university level studies, and education. The string of keyworks were then combined by the "AND" operator and were applied to all selected databases, completing our search strategy. Search results from each database were then exported to Covidence for screening.

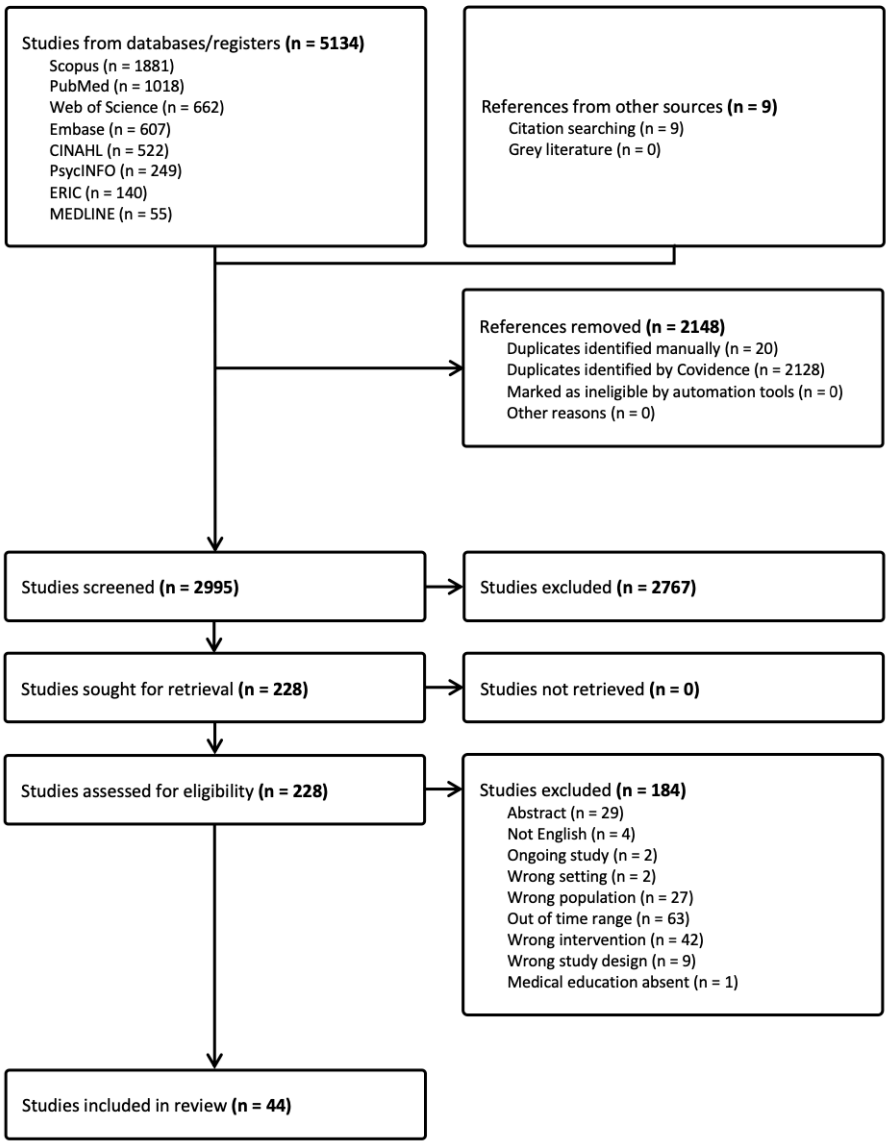
This review utilizes screening procedures to identify studies that meet selection criteria, adhering to an internation guideline called the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA 2020; Page et al., 2021). The selection criteria include restrictions on source, year, study level, discipline, group size and the presence of gamification and medical education. Studies were excluded if their methodology was badly reported and if the study was ongoing. These studies were screened using an online tool called Covidence (Covidence systematic review software, 2024), which allowed reviewers to independently access study abstracts and full text on an easy-to-use website, facilitating the review process. The screening process included the importation of relevant citations and the removal of duplicates. Then, the abstracts of all studies were screened for relevance, where studies related to the review topic were included for full text screening. Full-text screening, as the name implies, involves the screening of full study articles to determine whether they meet our selection criteria. Papers that were included after full-text screening were prepared for data extraction.

After the screening process was complete, we extracted data from all included studies and exported them as .csv files for processing. Data extraction involved the manual identification of important information from studies, including general information about the study, participant characteristics, methodology and outcomes. Some data were coded for easy interpretation while others were more descriptive to capture the uniqueness of studies. Quality assessment was performed by the Medical Education Research Study Quality Instrument (MERSQI; Reed et al., 2007) and a new Modified-MERSQI (MMERSQI; Al Asmri, 2023). The choice to use two versions of the MERSQI was made since the original version was much more commonly used, while the lesser-known modified version adds new criteria in MERSQI items to provide a more comprehensive quality assessment. Due to its higher specificity in scoring, the MMERSQI was chosen as the primary quality assessment instrument. After data extraction, the frequency of game type and design, and the presence of significant outcomes were analyzed. Logistic regressions were performed on study quality and game type to investigate how well they predict the likelihood of significant outcomes. Data analysis is still ongoing and preliminary results will be provided in the next section.

Preliminary results

Literature search

This review searched through eight electronic databases and identified 5134 studies from our search terms. Of these studies, 2148 were duplicates and were removed, leaving 2995 studies to be screened. Abstract screening further excluded 2767 studies from the review, leaving 228 studies to be screened. Of the 228 studies that have undergone full text screening, 44 studies were deemed eligible and were prepared for data extraction. The PRISMA flowchart below summarizes the review process.



Quality assessment

All included studies passed through quality assessment. The mean MMERSQI score was 54.41 out of 100 (SD = 8.696), while the mean MERSQI score was MERSQI was 10.39 out of 18 (SD = 1.967; Table 1). The highest score on the MMERSQI was 88 from a randomized controlled trail, while the lowest was 40 from a single group post-test trail. While the scales were highly correlated ($r = .877$, $p < .001$), a pair samples t-test (Table 2) indicated that studies had significantly higher MERSQI percentage scores (M = 0.577, SD = 0.109) than MMERSQI percentage scores (M = 0.544, SD = 0.087; $t = -4.103$, $p < .001$, Cohen's $d = -0.619$).

Table 1
Quality assessment descriptives

	MMERSQI score	MERSQI score	MMERSQI percentage	MERSQI percentage
N	44	44	44	44
Missing	0	0	0	0
Mean	54.409	10.386	0.544	0.577
Median	55.000	10.500	0.550	0.583
Standard deviation	8.696	1.967	0.087	0.109
Minimum	40.000	6.500	0.400	0.361
Maximum	88.000	14.500	0.880	0.806

Table 2

Paired samples t-test between MMERSQI and MERSQI percentage scores

Assessment tool	Mean (Percentage)	SD	Mean difference	*t*(43)	*p*	Cohen's *d*
MMERSQI	0.544	0.087	-0.033	-4.103	< .001	-0.619
MERSQI	0.577	0.109				

Population descriptives and study design

The number of participants ranged from 18 to 786 students from two or more disciplines, with nursing being the most common aside from medicine. All participants were postgraduate or undergraduate students at the time of intervention. As the analysis of disciplines characteristics is still ongoing, further details will be provided in the future. As for the study designs, most studies adopted a single group pre-test and post-test design (n = 25), while randomized control trials were the least common (n = 5). A breakdown of study design frequencies can be seen in Table 3

Table 3
Frequencies of study designs

Design	Studies	% of Total	Cumulative %
Randomised controlled trial	5	11.4 %	11.4 %
Single group post-test only	14	31.8 %	43.2 %
Single group pre-test & post-test	25	56.8 %	100.0 %

gIPE elements and learning objectives

Of the 44 studies included, 36 (81.8%) adopted role-play simulations (RPS). Four of the remaining eight studies used strategy games, while the other four used escape rooms. Four main game themes were found, they include emergency medicine (ER; n = 12), patient care (PC; n =12), hospital safety and management (HSM; n =4), and other specialties (OS; n = 16). Outcomes were classified as either interprofessional competency (IPC) or knowledge and skill acquisition (KSA) outcomes. IPC outcomes focused on the development of interprofessional communication and teamwork skills, while KSA outcomes focused on the

acquisition and reinforcement of medical knowledge or skills. Most studies had both IPC and KSA (n = 25, 56.8%), while 19 studies (43.2%) had only IPC outcomes.

Study outcomes

The analysis of study outcomes is incomplete and more detailed data will be available in the near future. However, a preliminary analysis showed that all studies revealed at least one positive outcome and only 8 studies had negative results, these outcomes mainly focused on interprofessional competencies (n = 44) and knowledge or skill attainment (n = 25). Of the 44 studies, 29 yielded significant positive results ($p < .05$), while the no significant negative results were found. Results from logistic regressions further revealed that the type of game element was not associated with significant study outcomes, rather, increasing study quality (MMERSQI scores) was significantly associated with an increase in the likelihood of significant outcomes (Table 4; *OR* = 1.15, 95% *CI* [1.03, 1.28], *p* = .011).

Table 4

Logistic regression of the presence of significant outcomes on MMERSQI scores

Predicted variable	Predictor	Estimate	SE	*z*-value	*p*	*OR*
All significant outcomes	Intercept	-6.698	2.880	-2.326	0.020	0.001
	MMERSQI	0.139 [a]	0.055	2.532	0.011*	1.149
Model Fit Measures						AUC
Deviance	R^2_{McF}	AIC	χ^2	*p*		
47.982	0.150	51.982	8.482	0.004*		0.754

[a] log odds of " All significant outcomes = Y" vs. " All significant outcomes = N"

Game types and neuropsychological analysis

This section has not yet been completed. Results will be provided by late October 2024.

Discussion

The purpose of this systematic review was to investigate the current evidence for an overall effect of gIPE on the attainment of learning outcomes in medical education; to examine the novelty and quality of included studies; and to explore existing psychological and cognitive neuroscience studies backing the effectiveness of identified game elements in interprofessional medical education.

Currently, our preliminary analysis has found overwhelming positive evidence for the use of gamification in interprofessional medical education. Most evidence supporting positive learning outcomes through gIPE were significant and was positively associated with higher study quality, suggesting that studies with a higher quality of evidence and more robust designs would be more likely to detect these outcomes. The MERSQI scores we have obtained were comparable to those of other studies. For instance, a systematic review on the gamification of health professions education found a mean MERSQI of 9.84 (van Gaalen et al, 2021), while our study found a mean of 10.50. This indicates a trend of average study quality in this field of research and more double-blind randomised controlled trails could be carried out to provide quality evidence. In this systematic review, game type did not seem to be significantly associated with the likelihood of significant outcomes.

As for the frequency of game elements used, role-play simulations were the most prevalent type of game utilized in learning activities. We believe that the ease of access and simple

execution of role-play simulations may be the reason behind its frequent use. These games were used to enhance learning objectives, and in these studies, all objectives were related to interprofessional competency while over half of them also had objectives related to the acquisition and reinforcement of medicine related skills and knowledge. In general, objectives related to interprofessional competency were measured with more validated and standardized inventories and scales, while medical knowledge and skills were often measured by study-specific questionnaires. Quantitative and qualitative data for the results of these studies are still being analysed, and we aim to finish data analysis by November 2024.

Upcoming future data analysis will first focus on the novelty of each study and will present a list of findings aside from positive-neutral-negative and significant-insignificant descriptions. This will hopefully summarize and preserve the unique findings of each study while keeping this review organized. Following the analysis of results, this review will then examine the neural correlates and psychological theories behind escape rooms, role play simulations and strategy games. Finally, other methods of analysis are proposed but not necessarily adopted, including a synthesis of results from the Readiness for Interprofessional Learning Scale across seven studies using the same scale and with the same study design. This would provide a more in-depth analysis of study outcomes, specifically, that of interprofessional competencies. We are working on a manuscript to be published this year, and we hope to reach all the targets above.

Learning experience

This summer research project has been fulfilling and rewarding. In the span of 6 weeks, I have learnt the basics of conducting systematic reviews, reinforced my understanding of medical education and the psychology behind gamification and interprofessional education.

Though the procedure of conducting systematic reviews was foreign to me at the start of the attachment, and I did, in fact, encounter many setbacks throughout the summer, I was rather surprised by my ability to tackle all these problems one step at a time and produce a final product. While my systematic review is not complete, I was satisfied by my hard work as an independent reviewer and by the design of my data extraction template and research methodology. Though this learning experience, I have learnt many research skills and tricks only acquired by mentorship and hands-on experience. For instance, how to organize my thoughts and consolidate ideas in academic papers, and how to structure my review clearly and professionally. These skills were especially valuable as an undergraduate majoring in research intensive fields and would undoubtedly facilitate my future pursuits in academia.

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References

van Diggele, C., Roberts, C., Burgess, A., & Mellis, C. (2020). Interprofessional education: tips for design and implementation. *BMC Medical Education*, *20*(Suppl 2), 455. https://doi.org/10.1186/s12909-020-02286-z

Curran, V. R., Sharpe, D., Flynn, K., & Button, P. (2010). A longitudinal study of the effect of an interprofessional education curriculum on student satisfaction and attitudes towards interprofessional teamwork and education. *Journal of interprofessional care*, *24*(1), 41-52. https://doi.org/10.3109/13561820903011927

Karam, M., Brault, I., Van Durme, T., & Macq, J. (2018). Comparing interprofessional and interorganizational collaboration in healthcare: A systematic review of the qualitative research. *International journal of nursing studies*, *79*, 70-83. https://doi.org/10.1016/j.ijnurstu.2017.11.002

Morley, L., & Cashell, A. (2017). Collaboration in health care. *Journal of medical imaging and radiation sciences*, *48*(2), 207-216. https://doi.org/10.1016/j.jmir.2017.02.071

van Gaalen, A. E., Brouwer, J., Schönrock-Adema, J., Bouwkamp-Timmer, T., Jaarsma, A. D. C., & Georgiadis, J. R. (2021). Gamification of health professions education: a systematic review. *Advances in Health Sciences Education*, *26*(2), 683-711. https://doi.org/10.1007/s10459-020-10000-3

Majuri, J., Koivisto, J., & Hamari, J. (2018). Gamification of education and learning: A review of empirical literature. In *Proceedings of the 2nd international GamiFIN conference, GamiFIN 2018*. CEUR-WS. http://ceur-ws.org/Vol-2186/paper2.pdf.

Krishnamurthy, K., Selvaraj, N., Gupta, P., Cyriac, B., Dhurairaj, P., Abdullah, A., ... & Ang, E. T. (2022). Benefits of gamification in medical education. *Clinical Anatomy*, *35*(6), 795-807. https://doi.org/10.1002/ca.23916

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Aki, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S.,...Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *PLOS Medicine, 18*(3), Article e1003583. https://doi.org/10.1371/journal.pmed.1003583

Covidence systematic review software (2024). Veritas Health Innovation. Melbourne, Victoria, Australia.

Reed, D. A., Cook, D. A., Beckman, T. J., Levine, R. B., Kern, D. E., & Wright, S. M. (2007). Association between funding and quality of published medical education research. *JAMA*, *298*(9), 1002–1009. https://doi.org/10.1001/jama.298.9.1002

Al Asmri, M., Haque, M. S., & Parle, J. (2023). A Modified Medical Education Research Study Quality Instrument (MMERSQI) developed by Delphi consensus. *BMC medical education*, *23*(1), 63. https://doi.org/10.1186/s12909-023-04033-6