Development of a mobile application to increase motivation, engagement & teaching activity of clinical faculty using gamification principles

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Abstract

Background: Clinician teachers (CT) have historically felt undervalued and underappreciated. One technology used to increase motivation is gamification: the process of inserting elements of game-playing into activities that are not usually associated with games. We developed a mobile application that rewards CTs using in-app gamification techniques to increase CTs motivation. This program was implemented specifically in a regional campus setting, Mississauga, Ontario.

Methods: A cross-platform application that rewards physicians for their clinical teaching hours was created. This consisted of a star grading criteria where each physician was awarded depending on the number of hours completed. End-user perceptions of the application were evaluated using a survey with a Likert scale and open-ended questions. Survey results were collated with descriptive statistics and thematic analysis.

Results: The TutorTracker application was developed implementing a live gamification algorithm. It allows physicians to view their hours completed, rewards obtained, and add additional hours. The majority of CTs agreed or strongly agreed that the application was user-friendly, easy to navigate and enjoyed the rewards provided. Major themes that emerged were regarding additional features and full integration of such an application for rewarding teaching efforts.

Conclusions: Gamification principles have been implemented in a cross-platform application allowing CTs to be rewarded for their teaching. The next steps would be to formally quantify the effects and advantages of using the application to increase the motivation of tutors.

Keywords: gamification; motivation; medical education; tutors.

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Background

Education is one of the fundamental pillars of an academic healthcare institution[, 2]. Traditionally, metrics that relate to grant funding or publication of research works have been central towards physicians working at academic medical institutions gaining formal recognition and promotion, with their clinical teaching responsibilities being deemed increasingly less important[3-5]. This has led to clinical tutors (CTs), who do the majority of teaching at medical institutions, being overlooked for academic rewards, given less institutional recognition, and considered less for promotion[6-8]. As a result of this lack of institutional recognition, the motivation of clinical tutors has become deeply reliant on intrinsic factors such as their own passions for medical education[8]. Due to their integral role in educating future physicians, it is imperative that academic medical centres value the contributions of CTs toward medical education.

Efforts have been put forth to recognize clinical tutors in the past. In particular, guidelines on reward systems for teaching have been proposed, while other institutions have implemented promotional tracks for clinicians primarily involved in educational duties[10, 11]. However, the effectiveness of these methods has been questioned, with no clear solution firmly established. In addition, problems such as inconsistent evaluation metrics, lack of transparency, and personal bias with these solutions have been raised[9, 10].

The key to improving the satisfaction of clinical tutors is ensuring they are engaged with their work and motivated to conduct their teaching duties[11]. It is important to understand the motivations and challenges of these clinician tutors, specifically in distributed medical education settings. Many preceptors feel a sense of personal fulfilment in interacting with learners; seeing learners throughout time as they grew in skills and confidence while overcoming obstacles seems to be an intrinsic motivator and benefit to many preceptors. Many clinician tutors also talk about professional benefits such as having better access to opportunities for mentorship, leadership, and faculty development. However, many clinician tutors also face challenges, and the biggest one is additional compensation for

the time and effort being put into learners in medical education settings. With time management being one of the greatest challenges, supervising learners could mean extra time spent on teaching and administration which can lead to longer days for these clinician tutors. Some preceptors also talk about having a "slowdown in the clinic" with learners or have had to decrease clinical hours to compensate, impacting their finances. Although there are challenges impacting time, effort, and energy that clinician tutors must deploy for learners, it is important to also see other benefits and cumulative positive impacts and overall improve motivation in teaching duties[12]. One method that has been successfully implemented to improve compliance and motivation of patients in a variety of health contexts is gamification. Gamification may be defined as the process of inserting elements of game-playing into activities that are not usually associated with games to increase motivation, participation, and engagement[13]. A recent systematic review of 576 gamification studies in e-health demonstrated that using game mechanics such as points, leaderboards, levels, and feedback may increase recruitment and retention for patients in the health fields[14]. Gamification principles have been used on mobile applications in a variety of health contexts including diabetes, breast cancer, and cardiac health to improve compliance and motivation[15-17]. However, there is a paucity in the literature regarding the use of gamification to motivate or engage educators in health professions.

To address this need, the TutorTracker (© 2020 TutorTracker) mobile application was created, specifically aimed at improving the motivation of clinical tutors through gamification methods[18]. This was implemented in a regional campus setting, in Mississauga, Ontario. As such, we would like to investigate whether the use of a mobile application could be used to improve the satisfaction rates of clinical tutors. The purpose of this study is to report on the development of such an application and report how CTs perceive the implementation of such an application.

Methods

Study Design

This study was designed as a quality improvement (QI) project at the University of Toronto, Mississauga Academy of Medicine (MAM) through the Trillium Health Partners (THP) hospital network. The study utilized the Plan-Do-Study-Act (PDSA) cycle methodology to iteratively test and refine the intervention. Appropriate Research Ethics Board (REB) exemption was obtained due to the nature of the project.

Plan (P)

The initial phase involved planning the development and deployment of the TutorTracker mobile application aimed at improving the motivation of clinical tutors (CTs) through gamification methods. Key stakeholders, including CTs, education administrators, and IT developers, were consulted to identify specific features and functionalities that would be most beneficial. A baseline survey was conducted to assess the current levels of satisfaction and motivation among CTs, focusing on their perceptions of recognition and reward for their teaching efforts.

A stepwise gamification algorithm was developed that allowed live updates from users. This consisted of a star grading criteria where each physician was awarded a bronze, silver, or gold star depending on the number of hours completed. This simple algorithm was used as gamification principles indicate the most effective gamification implementation starts with simple algorithms that eventually become more complex over time[19].

Implementation (D)

The TutorTracker application was developed using the Ionic development framework[20]. The application was designed as a progressive web app (PWA) and deployed to both Android and Apple phone applications[21]. Google's Firebase framework was used for authentication and database hosting services. The application was designed and built by two of the authors (AA, SM), and iterated upon over a one-year timeline. The initial implementation of the app included features such as a star grading system (bronze, silver, gold) based on hours completed, virtual badges, and a summary of teaching history.

Learning (S)

To evaluate the effectiveness and usability of the TutorTracker application, a mixed-methods approach was employed to determine end-user perceptions of the application. Quantitative data were collected through an anonymous online survey that was sent to 50 faculty members at the Mississauga Academy of Medicine (MAM). The survey consisted of eight 5-point Likert scale questions and three open-ended questions. Likert scale questions were scored by assigning an integer value between 1 (Strongly Disagree) to 5 (Strongly Agree), with totals calculated for each question.

Open-ended questions included:
1. Please elaborate on areas of the application you enjoy using.
2. Please elaborate on areas where you think the application may be improved.
3. Please provide any final thoughts/feedback.

Survey results were collated using descriptive statistics using counts, percentages, and total scores. Thematic analysis based on Braun and Clarke's six phases was used to extract key themes from the open-ended responses. These six phases are as follows: 1) becoming familiar with the data, 2) generating codes, 3) generating initial themes, 4) reviewing themes, 5) defining and naming themes, and 6) producing the report.

Treatment (A)

Based on the findings from the 'Study' phase, modifications and improvements were made to the TutorTracker application. Results from the survey and the open-ended questions were considered in the integration and development of the app. Key feedback such as the integration of a ranking system, live rewards and achievements, calendar integration, and profile customization were prioritized. Subsequent PDSA cycles were planned to iteratively test these new features, with continuous feedback loops involving the same cohort of faculty members to ensure the application meets their needs and improves their motivation.

Table 1. Breakdown of results from Likert questionnaire distributed to clinical tutors evaluating their experiences using the TutorTracker application.

Survey Question	Survey Response, n (%)					Total Score
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
1. The application has a user-friendly experience	0 (0)	0 (0)	4 (24)	8 (47)	5 (29)	52
2. The application is easy to navigate	0 (0)	0 (0)	2 (12)	12 (71)	3 (18)	52
3. The teaching hours are displayed in a user-friendly manner	0 (0)	0 (0)	5 (29)	8 (47)	4 (24)	50
4. The rewards are displayed in a user-friendly manner	0 (0)	0 (0)	5 (29)	6 (35)	6 (35)	52
5. I can easily add new hours that I have completed	0 (0)	0 (0)	3 (18)	10 (59)	4 (24)	52
6. I enjoy the rewards provided by the application	0 (0)	0 (0)	6 (35)	11 (65)	0 (0)	45
7. I find the application useful for tracking my clinical teaching hours	0 (0)	0 (0)	4 (24)	9 (53)	4 (24)	51
8. I find the application useful for recording my CME hours	0 (0)	1 (6)	4 (24)	10 (59)	2 (12)	47

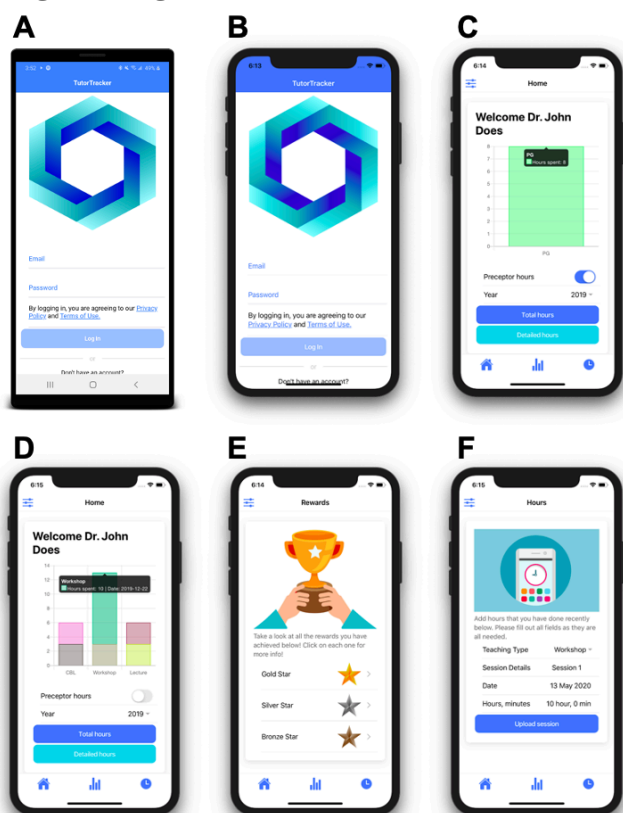CME: Continued medical education

5 Figure Legend

Figure 1. Screenshots of TutorTracker application at various phases. A) Android login; B) iOS login; C) General view of hours; D) Detailed view of hours; E) Rewards tab; F) Uploading hours tab.

Results
TutorTracker Application
Together with Google's Firebase console API and the cross-platform and open-source development framework Ionic, we successfully developed a mobile application named TutorTracker that allows CTs to easily submit yearly hospital and university renewals, as well as document yearly continuing medical education (CME). Currently available on both the iOS and Android application stores, physicians may easily track their clinical teaching using various parameters such as hours of teaching, date, subject and course. The application rewards physicians using virtual badges, for quantity and diversity of teaching and provides a summary of the physician's clinical teaching history. Hours were broken down according to undergraduate and postgraduate teaching, with a three-tiered reward system based on the number of hours completed used as the reward system: 1) Bronze star (0-50 hours), 2) Silver star (50-100 hours), 3) Gold star (100+ hours). Figure 1 shows the overall design and functionality of the application.

Evaluation of Application
Survey results are summarized in Table 1. Overall, 17 out of 50 faculty members responded to the survey, a 34% response rate. Regarding responses, the majority agreed or strongly agreed that the application was user-friendly, was easy to navigate, the rewards were displayed in a user-friendly manner, and they could easily add the hours completed (Table 1). In addition, the majority of them agreed or strongly agreed that they enjoyed the rewards provided by the application and found the application useful for tracking clinical teaching hours as well as continued medical education (CME) hours (Table 1).

Regarding usage, the majority of users (82%) indicated that they used the application 1-3 times per week, with the rest (18%) indicating they used it 4-5 times per week.

Regarding additional features missing from the application, the most requested additional feature from the application was to display their ranking relative to other tutors (71% of participants), followed by live rewards and achievements (65%), integration into their billing system/calendar (59%) and profile customization (59%).

The major themes that emerged from the open-ended questions were regarding additional features, in particular improvement of user experience and integration into their current billing system/calendar.

The other major theme highlighted was moving towards the full integration of such an application to be used to reward the efforts of clinician teachers, as it was felt the current reward system is lacking.

From the open-ended questions that were presented, there were several themes that arose through analyses.

Theme 1: Integration into Calendar
- This included features to improve user experience such as integration of information and key dates into the personal calendars of clinician tutors. Integration into their billing system or calendar was requested by 59% of participants as an additional feature to be added to the application.

Theme 2: Comparative Rankings
- In addition, providing a comparison of rankings compared to other clinician tutors could also be beneficial. The most requested additional feature from the application was to display their ranking relative to other tutors (71% of participants)

Theme 3: Live Rewards and Achievements
- Providing live rewards and achievements can also promote motivation. The second most requested additional feature from the application was live rewards and achievements (65% of participants).

Theme 4: Remuneration Information
- Monetary compensation as an extra feature in this process can also be a motivator and beneficial in extrinsic motivation to clinician tutors (24% of participants).

Theme 5: Profile Customization
- Customization of clinician tutor profiles with aspects such as a picture, name, and/or email was also requested as an additional feature in the application by 59% of applicants.

Discussion

This study evaluated a unique approach to improve the experience of clinician educators. In particular, gamification principles have been successfully

harnessed to develop a mobile application that allows clinician teachers to be tracked and rewarded for their educational duties. The results of this work will greatly contribute to furthering not only the experience of clinical teachers but also those whom they educate, with the potential to have a net positive impact on medical education.

Rooted in the Canadian literature on DME faculty engagement, this study aligns with previous findings on the importance of supporting both intrinsic and extrinsic motivations to teach. Gamification has been successfully applied across various healthcare fields, from diabetes to breast cancer, primarily to enhance motivation and compliance. Additionally, it has been widely used in education, employing design elements such as points, levels, and badges to enrich the learning experience. This study has successfully implemented these principles in a healthcare education context, focusing on improving the teaching experience of clinical tutors—a novel approach in the literature.

The application we developed not only serves as a practical tool but also builds upon findings from previous studies on Canadian DME faculty, which highlight key motivators for teaching, including financial incentives, the need for varied reward types, and the significance of intrinsic motivation[22]. For instance, requests for integration with billing software reflect financial motivation, while integration with CME requirements supports the intrinsic drive to teach[23]. The need for on-demand rewards highlights the diversity among preceptors and their varied preferences for recognition, as observed in the literature[12].

Our approach, utilizing real-time feedback, tracking work hours, and providing immediate rewards offers significant advantages over traditional methods like guidelines and promotional tracks. Furthermore, it opens the door to applications beyond tutor motivation, such as tracking continuing medical education (CME) hours. This innovative use of gamification through mobile technology leverages the findings of several Canadian DME faculty studies, offering a practical solution that meets the diverse needs of clinical educators. In an increasingly digital

world, it is crucial that such methods be adopted by leaders in medical education.

Here we successfully used two of the largest phone platforms and implemented it at a local campus level. There was a clear positive response from tutors who participated in feedback, and there was growing interest in the implications of this application. While a quantifiable effect on the motivation of clinical tutors was not measured, this study provides a framework for future work of studying this effect size as well as expanding this work to other campuses. By aligning with the intrinsic and extrinsic motivators identified in previous studies, this approach could enhance retention within the role of clinician tutors, serving as a valuable asset in the pursuit of promotion and tenure. Additionally, it could serve as an expedient method to provide mentees with a succinct, yet comprehensive understanding of the responsibilities and intricacies involved in functioning as a clinician tutor or even as a community-based preceptor. Future studies may look to more closely evaluate the effect size, which may contribute to the overall improvement in clinical tutor experience and motivation.

Survey question 6 in Table 1 mentions "I enjoy the rewards provided by the application." This point seemed to receive the lowest total score. To address this issue and increase total scores in future cycles, specific actions can be planned and included as part of the process. One action to incorporate into the future would be enhancing the diversity and appeal of rewards by including user-suggested rewards. Introducing a ranking system that can be implemented can also show users their performance relative to peers. In addition, introducing more features may also be beneficial. These include options such as live rewards and achievements, calendar integration, and profile customization. Conducting focus groups with clinician tutors is also a benefit for future improvement. Subsequent PDSA cycles will focus on these modifications, with continuous feedback loops involving the same cohort of faculty members to ensure that the application meets their needs and improves motivation among clinician tutors.

This study does present limitations. The application was only deployed on iOS and Android, with other platforms like mobile watches and computers not implemented due to resource constraints. Future work should broaden these applications to maximize engagement. The application was also not well integrated into the clinical workflow, requiring manual updates from physicians, which is time-consuming. Future iterations may integrate the application with clinical schedules and calendar applications to streamline the workflow. Moreover, recognizing the diverse needs of DME faculty, as highlighted in the literature, is essential when implementing long-term software solutions, particularly regarding the cost implications and scalability. Lastly, as this was a pilot study, we did not measure the true effect size on tutor motivation. Future studies should deploy such applications prospectively to accurately measure their impact. An example might be a prospective two-arm mixed methods cohort study, with one arm using the application and the other as a control, measuring clinical tutor satisfaction using a validated scale like the modified teaching satisfaction scale (mTSS)19.

In conclusion, gamification principles have been effectively implemented to develop a cross-platform mobile application allowing clinician teachers to track and be rewarded for their educational responsibilities. Rooted in and building upon existing literature on DME faculty engagement, this study offers a practical approach to enhancing clinical tutor motivation. In the regional campus setting of Mississauga, we were able to show success thus far in understanding how the initial response to this work has been positive, with most clinician teachers reporting that they are satisfied with the application. The next steps would be to formally quantify the effects and advantages of using the application to increase the motivation of tutors. In addition, further improvements to the application may be considered such as profile customization, integration with calendar applications, and the integration of artificially intelligent models into the gamification algorithms.

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