

Evaluation of affective learning in a gamified pharmacy simulation

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Abstract

Introduction: Pharmacy students must achieve learning in the affective domain to attain the professional values that underpin patient-centred practice and self-directed, lifelong learning. An array of learning and teaching activities, including gaming and simulation, are used to achieve affective learning. The aim of this research was to evaluate affective learning in participants of an extended, immersive, gamified pharmacy simulation.

Methods: Student teams managed simulated pharmacies, assuming the role of autonomous pharmacists to complete regular, scaffolded, pharmacy-related tasks and safely provide medicines and counselling. The 3-week gamified simulation was designed to develop teamwork and collaborative skills, while enhancing students' professional identity, confidence and competencies. Affective learning was assessed via analysis of student reflective journals. Final-year pharmacy students completed debriefing and reflection at specific timepoints during participation in the 3-week gamified simulation. The validated Griffith University Affective Learning Scale (GUALS) was used by trained external assessors to evaluate the highest levels of affective learning detected in student reflective journals. Quantitative analysis of GUALS scores was conducted using SPSS 25. Means were computed per student for each week, regardless of journalling frequency, and changes over time compared.

Results: From 2016 to 2018, 123 students participated in the simulation, generating 734 reflective journal entries for analysis. Overall, affective learning was evident, and its level increased over the course of the simulation. This was primarily associated with the improvements of female students.

Conclusion: An extended, immersive, gamified pharmacy simulation induced and enhanced affective learning in final-year pharmacy students.

Keywords: pharmacy education; gamification; simulation; affective learning; professional development; students

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Introduction

Pharmacy students are expected to attain profession-specific knowledge, skills and attitudes, that, respectively, align with the three broad domains of cognitive, psychomotor and affective learning, as defined in Bloom's taxonomy (Bloom et al., 1956). The taxonomy was developed in the 1950s and is widely acknowledged by educators. Traditional learning and teaching activities are typically directed at the cognitive and psychomotor domains, in which students acquire requisite knowledge and skills. Donlan (2018) suggested that students must also demonstrate achievement of learning outcomes in the affective domain to become patient-centred professionals. Affective learning involves the acquisition of values, attitudes and motivation that underpin development of professional identity and self-directed, lifelong learning practices (Brown et al., 2001; Buissink-Smith et al., 2011; Miller, 2005; Rogers et al., 2017). Krathwohl (1964), one of Bloom's original co-authors, proposed five hierarchical levels of affective learning, with each transitioning to the next. Krathwohl described the levels as *receiving*, wherein students receive stimuli and passively attend to them; *responding*, in which students willingly respond to stimuli on request; *valuing*, wherein students value the activity and seek out ways to respond; *organisation*, in which students organise the values into systems and the value complex into a whole; and *characterisation*, wherein students internalise and fully integrate the affective learning into their overall worldview.

Facilitating and assessing student learning in the affective domain is notoriously challenging (Buissink-Smith et al., 2011; Donlan, 2018; Rogers et al., 2017). Strategies to support affective learning should therefore be realistic and relevant (Miller, 2005) and designed to stimulate personal reflection (Bhoopathi & Sheoran, 2010). Such strategies include roleplay, reflective journaling, simulation and gaming (Akl et al., 2013; Andrusyszyn, 1989; Donlan, 2018; Lean et al., 2006; Lewis et al., 1989; Schoenly, 1994; Weigel & Bonica, 2014). In pharmacy education, additional strategies include authentic practice exposure and interaction with professional role models to facilitate professional identity development (Mylrea et al., 2017, 2019). Twenty years ago, a call to action was published for pharmacy educators, encouraging the creation of teaching methods that would "light the fire" of affective learning to nurture students' professional development (Brown et al., 2001).

A potential approach to teach and assess all three learning domains is to utilise gamified simulation. Gamification involves adding gaming elements to something that is essentially not a game (Deterding et al., 2011; Kim, 2015). Gaming elements might include the game story, scoring, competition and consequences (Landers et al., 2018; Prensky, 2001; Schwabe & Göth, 2005). Gamification can make nongame tasks more interesting and enhance participant motivation, engagement and value creation (Vesa & Harviainen, 2019). The educational approach evaluated in this study was an extended, immersive gamified pharmacy simulation. Exploration of learning in the affective domain may provide insight into the impact of teaching initiatives, such as gamified simulation,

and is essential to the complete evaluation of associated learning outcomes (Andrusyszyn, 1989).

Aim

To assess the affective learning experienced by final-year pharmacy students during participation in an extended, immersive, gamified simulation through analysis of student reflective journals.

Methods

This manuscript was prepared with reference to the *SQUIRE-EDU (Standards for Quality Improvement Reporting Excellence in Education) Publication Guidelines for Educational Improvement* (Ogrinc et al., 2019).

Gamified simulation

The pharmacy simulation involved final-year pharmacy students competitively managing simulated pharmacies full-time over an extended 3-week period, during which no other classes were timetabled (August–September 2016–2018). In-person student participation encouraged immersion in the activity. The simulation was conducted as a capstone event towards the end of the students' pharmacy degree and was developed to address an identified local gap in which pharmacy students had limited exposure to the complexity and interconnectedness of real-world practice. Capstone activities aim to consolidate prior learning, delivering a culminating learning experience (Hirsch & Parihar, 2014; Phillips et al., 2019). The gamified simulation was based on the Pharmacy Game developed at the University of Groningen, The Netherlands (Fens et al., 2020; van der Werf et al., 2004). The educational approach has been adopted by a consortium of universities for the education of both medical (Van Rossem et al., 2019) and pharmacy (Fens et al., 2020; Fens et al., 2021; Koster et al., 2017) students. A detailed description of the gamified simulation has been published elsewhere (Hope, Grant, et al., 2021).

During the gamified simulation, students assumed the role of autonomous pharmacists in all decision making, actions and communication. This provided an opportunity for active learning in an interactive environment (Aburahma & Mohamed, 2015; Baker et al., 2008) and experiential learning, which involves the experience of being in a professional role (Kolb, 1984; Tomkins & Ulus, 2015). The activity presented a range of authentic, complex and interconnected pharmacy tasks focused on the safe provision of medicines and advice to simulated patients and encouraged interprofessional communication and collaboration. This approach aligns with self-determination theory, in which authentic learning informs the development of professional identity (Mylrea et al., 2017). Pharmacist academics consciously scaffolded all simulation tasks, which were continuously assessed during the simulation, with consequences of practice recognised via the gain or loss of pharmacy "patients". The gamified simulation aimed to develop the skills of teamwork and collaboration while enhancing students' professional identity,

confidence and competencies (Fens et al., 2020; Fens et al., 2021; Hope, Rogers, et al., 2021).

Regular debriefing was undertaken across the 3 weeks in the form of pharmacy staff meetings, as debriefing during simulation allows participants to explore their emotions and the events and outcomes and facilitates reflection (Kolbe et al., 2020). Reflection is acknowledged as a vital skill for health professionals, which helps inform the development of professional identity and expertise (Black & Plowright, 2007; Brown et al., 2015; Mantzourani et al., 2019; Mylrea et al., 2017). Pharmacy students had previous experience with reflective journalling, having received prior and repeated instruction on various types of personal reflection.

Participants

Student participants in the gamified pharmacy simulation were enrolled in either a 4-year undergraduate Bachelor of Pharmacy degree or a 2-year intensive post-graduate Master of Pharmacy degree between 2016 and 2018.

Students who agreed to participate in the research provided written consent for the research team to access their deidentified journal entries upon completion of the simulation and the end of their academic relationship with the researchers.

Assessing affective learning

Assessing affective learning is considered complex, as it attempts to quantify human emotion, beliefs and values. Despite this, checklists, scales and frameworks to assess affective learning have been discussed in literature (Andrusyszyn, 1989; Buissink-Smith et al., 2011; Glennon et al., 2015; Stephens & Ormandy, 2019). The Griffith University Affective Learning Scale (GUALS) was considered the most appropriate assessment tool for this research, as it was developed and validated for this purpose (Rogers et al., 2018) during an extended, immersive simulation involving medical students (Rogers et al., 2014; Rogers et al., 2017). The GUALS tool is used to allocate a numeric score to reflective journal entries based on the highest level of affective learning detected, utilising a “double hermeneutic” phenomenologically oriented method (Rogers et al., 2018). The scale was based on Krathwohl’s (1964) 5-level hierarchy and assigns scores at seven levels (where 1 equates to *no evidence of affective learning*, 2 to Krathwohl’s first level, *receiving*, 3 to *responding*, 4 to *valuing*, 5 to *organisation* and 7 to Krathwohl’s highest level, *characterisation*) (Rogers et al., 2018). Rogers et al. (2018) allocated a transition level between “organisation” and “characterisation” (which equates to a score of 6).

Data collection

Following multiple debriefing sessions during the 3-week simulation, students submitted typed reflective journal entries of 300–500 words, which were uploaded to the university learning management system. Students were provided with at least 8 hours in which to complete the task following the debriefing. Journal entries were externally assessed for

presence and quality of affective learning (Rogers et al., 2017) by pharmacists trained to use the GUALS tool (Rogers et al., 2018). The resultant GUALS scores were provided to participating student teams as aggregated scores, which contributed in part to the overall continuous assessment in the simulation. To encourage authentic reflection and avoid bias resulting from writing to a rubric, students had no access to the GUALS marking rubric. The journalling frequency was specific to the year and cohort of participation.

During the first iteration of the gamified simulation (in 2016), students reported that the daily requirement for written reflection was onerous. The SQUIRE-EDU reporting guidelines recommend iterative improvement in education, which aligns with university expectations to respond to student and staff feedback. As such, during the subsequent years of delivery, the academics supervising the simulation (DLH and GDG) experimented with varying journalling frequencies, which also accommodated increasing student numbers. The successive student cohorts were asked to submit journal entries twice weekly or weekly. This presented an additional opportunity to explore whether journalling frequency influenced affective learning.

Data analysis

Analysis of GUALS scores was quantitative, with means computed per student for each week, regardless of journalling frequency, and changes over time compared. SPSS 25 (IBM) was used to analyse data. Means and 95% confidence intervals were calculated for all students by gender and by journalling frequency.

A separate mixed-methods semantic and thematic analysis of the reflective journal entries was undertaken to explore experiential learning and has been published elsewhere (Hope, Rogers, et al., 2021). Findings included students' perceptions of the impact and experience of the simulation, relating to teamwork, collaboration and professional identity.

Institutional ethical approval was obtained from the Griffith University Human Research Ethics Committee (2016/594).

Results

One hundred and twenty-three final-year pharmacy students participated in the gamified simulation across 3 years from 2016 to 2018, generating 734 reflective journal entries. All students consented to the inclusion of their reflective journals in the analysis. Female students constituted 67.5% of enrolments and generated 69.3% of journal entries, suggesting that journal submissions were slightly more likely to be missed by males. The frequency of journalling was predominantly daily or twice weekly (Table 1).

Table 1*Participants, Reflective Journal Entries and Journalling Frequency by Year of Participation*

	2016		2017		2018		Total	
	Total	n (%)	Total	n (%)	Total	n (%)	Total	n (%)
Participants	27		47		49		123	
Male		8 (29.6)		15 (31.9)		17 (34.7)	40 (32.5)	
Female		19 (70.4)		32 (68.1)		32 (65.3)	83 (67.5)	
Journal entries	322		169		243		734	
Male		96 (29.8)		54 (32.0)		75 (30.9)	225 (30.6)	
Female		226 (70.2)		115 (68.0)		168 (69.1)	509 (69.3)	
Journalling frequency								
Daily		322 (100)		-		-	322 (43.9)	
Twice weekly		-		68 (29.3)		197 (81.1)	265 (36.1)	
Weekly		-		101 (68.7)		46 (18.9)	147 (20.0)	

GUALS analysis

Affective learning, as determined by GUALS analysis, was evident in almost all journal entries, and when all students were combined, its quality increased significantly with weeks spent in the simulation. Female students demonstrated significant improvement in GUALS scores over the duration of the simulation, whereas their male counterparts did not achieve significance in their improvement. The three journalling conditions, or frequencies, demonstrated significant improvement in affective learning over time, with twice weekly appearing to be somewhat more effective than the others (Table 2).

Exemplar text by GUALS score

Exemplar excerpts of journal text analysed for affective learning are presented in Table 3, organised by GUALS score.

Discussion

An extended, immersive, gamified simulation that includes regular debriefing and reflective journalling generated affective learning in pharmacy students, and the quality of affective learning (mean GUALS scores) increased over the course of the activity. This reinforces the findings of previous research that emphasised the importance of debriefing and reflection during simulation to facilitate affective learning and professional development (Black & Plowright, 2007; Brown et al., 2015; Kolbe et al., 2020; Mylrea et al., 2017). The significant increase in affective learning over the course of the

simulation provides important feedback to educators regarding the optimal duration of such activities. In this case, the affective learning increased week on week over the 3-week duration. This finding aligns with the research undertaken on Australian medical students who participated in an extended, non-gamified, immersive simulation during development of the GUALS tool, where the quality of students' affective learning significantly improved over the duration of the simulation (Rogers et al., 2018). The temporal results are also in line with the extended approach to gamified simulation utilised by other universities conducting gamified health professional simulation (Fens et al., 2020; Koster et al., 2017; Van Rossem et al., 2019).

Table 2

GUALS Scores and Confidence Intervals by Week for Gender and Journaling Frequency

Journals	Students	Journal Entries	Mean GUALS Score (out of 7)	95% Confidence Interval
Week 1: all	122	246	4.14	[3.92, 4.36]
Week 2: all	122	274	4.22	[4.01, 4.43]
Week 3: all	121	214	4.68	[4.48, 4.89]
By gender				
Week 1: male	40	76	3.90	[3.52, 4.28]
Week 2: male	39	84	4.11	[3.70, 4.52]
Week 3: male	38	65	4.39	[4.02, 4.77]
Week 1: female	82	170	4.26	[3.98, 4.53]
Week 2: female	83	190	4.27	[4.03, 4.51]
Week 3: female	83	149	4.81	[4.57, 5.06]
By journaling frequency				
Week 1: daily	27	108	4.17	[3.84, 4.49]
Week 2: daily	27	135	4.66	[4.35, 4.96]
Week 3: daily	27	79	4.69	[4.38, 4.99]
Week 1: twice weekly	45	88	3.94	[3.64, 4.25]
Week 2: twice weekly	46	90	3.96	[3.61, 4.30]
Week 3: twice weekly	46	87	4.59	[4.29, 4.88]
Week 1: weekly	50	50	4.30	[3.86, 4.74]
Week 2: weekly	49	49	4.22	[3.86, 4.59]
Week 3: weekly	48	48	4.77	[4.35, 5.19]

Table 3*Exemplar Journal Text by GUALS Score***1: No affective learning**

Just like a real pharmacy business every single member of the group has a role in the pharmacy. We have been receiving prescriptions, phone calls and people walking into our pharmacy asking different questions or requiring help from different topics. (P067, 2017)

We completed three days of practice during the final week of the PharmG game. Over these three days, we continued to dispense and consult patients within the OSCE simulations. (P086, 2017)

2: Receiving

After the OSCE ended and we were given feedback, the assessor told me what they believed wasn't very professional or best practice when it comes to dealing with patients in the pharmacy and there is more than one health professional involved. (P139, 2017)

I feel like this experience of having a small conflict and being able to resolve it will strengthen our group and it has already led to a change in our work-flow process that will hopefully improve our efficiency and reduce the chance of further problems. (P163, 2018)

3: Responding

This whole mix of different factors made me feel so frustrated and alone and disconnected. We weren't working like a team at all. (P025, 2016)

I feel so stupid for making this mistake and will always now double check my blurb about patient history before counselling even for templates I find myself doing very generic approaches and not tailoring my counselling to that patient. (P148, 2018)

4: Valuing

I have reflected on my nervousness and realised it's a lack of knowledge to me, so the more I know the less nervous I will be and even if it means building my knowledge on things I don't have passion for its [sic] critical for the overall profession to be multiskilled. (P148, 2018)

I usually doubt myself regarding my ability to perform a specific task unless I have a lot of experience with it. This habit restrains me only to complete the familiar tasks. I feel uncertain when I step out of my comfort zone. From this experience, I think probably I should step out of my comfort zone and take more responsibilities to sharpen my skills and seek feedback to improve. (P172, 2018)

5: Organisation

This made me feel confused and not satisfied with my approach. I think this happened because [I] read and analyse the clinical case with a set process. I believe that in order for me learn from this, I need to approach clinical cases differently. Having a set structure and guideline of obtaining key information and validating what is most important is something I can implement into practice. (P007, 2016)

During this time two particular patient interactions had a huge impact on me. ... Thus, these two events have illustrated the importance of obtaining a detailed history. This includes not only obtaining information about the presenting issue but also asking about all medications and other important relevant lifestyle questions. (P078, 2017)

6: Between organisation and characterisation

To resolve my issue I must use a combination of compromise, better efficiency and practice. While thorough patient counselling in [sic] important I think I may have to sacrifice every little detail for a deep exploration of the key issue. It will be a matter of practice to identify what these points are and I hope to learn the ability to prioritise my time during patient counselling. (P015, 2016)

This event has had a strong impact on me as this incident shaped the way I deal with situations and that if it is possible I should always ask for feedback as it will not only benefit me throughout the career, it will allow be [sic] to provide patient centred care. (P143, 2018)

7: Characterisation

My counselling method now is always stopping and making sure the patient is able to follow me throughout the interaction. I have been constantly asking: would you like me to go over this again? Any concerns? This had incredible outcomes, I can actually see how they get comfortable and become very thankful towards me. I believe this is because I was ensuring the best health care provision for them, through allocating time and effort for them. This made me extremely happy, honestly I am surprised how such small things can reward such satisfaction. (P004, 2016)

I have realised that I cannot, and do not need to "fix" my team but instead utilise my leadership abilities with their strengths to encourage involvement of a more dynamic, effective group. It has been a valuable experience learning how to collaborate effectively with individuals I wouldn't normally work with, as I am aware that I cannot choose whom I will be working with throughout my career. (P088, 2017)

This study was the first to apply the GUALS assessment scale to health professional students in disciplines other than medicine and provides a novel approach to quantifying the affective learning of pharmacy students. Pharmacy educators have used a wide range of activities to promote reflection and facilitate affective learning (Brown et al., 2015; McKauge et al., 2011), with recent approaches including podcasts (Matulewicz et al., 2020) and drawings (Rose & Unni, 2018), but few reports of affective learning outcomes have been published. Rose and Unni (2018) examined the affective emotional states of pharmacy students on placement through analysis of drawings, which were broadly categorised but not quantified. Given the lack of reporting on affective learning outcomes, this study makes an important contribution to knowledge.

Some gender differences were detected in this study, with females demonstrating significant improvement in affective learning across the course of the activity while males' improvement did not achieve significance. Similar gender differences were reported by Rogers et al. (2018), and together, these studies on adult learners might suggest gender differences in affective learning during immersive health professional simulation. Rogers et al. (2018) also suggested that the gender differences in affective learning outcomes might be accounted for by gender differences in writing capability. Education and psychology literature have long identified gender differences in learning approaches (Severiens & Ten Dam, 1994) and affective outcomes (Ma & Cartwright, 2003). Reber and Flammer (2002) suggested that during adolescence, males may develop inhibition of affective expression in comparison to females. This differential development may contribute to the gender differences detected and warrants further investigation.

Journalling frequency had limited impact on affective learning, which is important feedback for educators. Twice weekly journalling showed the greatest improvement in mean GUALS score over the course of the 3-week simulation, but the improvement was only slightly larger than for the other journalling frequencies. In the gamified simulation, daily reflection was anecdotally reported as a burden by both the students and assessors, and the results reveal that daily reflection may not be optimal to enhance affective learning. Dymont and O'Connell (2011) suggested that increased journalling frequency might positively influence the quality of reflection over time, however they also

conversely argued that students might become bored and that efforts at reflection might wane over time. Whether journalling frequency influences other outcomes of immersive health professional simulation is a potential area for future research. Furthermore, the optimal duration of gamified simulation in relation to affective learning is a topic for future research.

A strength of this research is the large volume of journal entries analysed over an extended period, with students from multiple pharmacy programs, both undergraduate and post-graduate. The use of trained external assessors and the fact that students were not exposed to the affective learning marking rubric helped to limit potential bias in this study.

A recognised limitation of this study is that it was undertaken with students of a single health profession during one particular type of activity. Student reflections were self-reported, which can also introduce bias, self-promotion or a lack of self-awareness (Stephens & Ormandy, 2019), but the double hermeneutic technique utilised in assessment through the GUALS methodology is deliberately designed to incorporate an estimation of the journal authenticity, which may mitigate this concern to some extent.

Conclusion

The validated GUALS scale appears to be suitable for assessing the affective learning of non-medical health professional students. An extended, immersive, gamified pharmacy simulation generated measurable affective learning in final-year pharmacy students, and the quality of this learning improved across the course of the activity. This is an impactful outcome, as affective learning is essential to development of professional identity and lifelong learning practices for pharmacists, and it might be expected to contribute to improvements in the quality of health professionals and health outcomes for individuals, communities and the overall healthcare system.

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