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Improving Patient Safety: Engaging Students in Interprofessional Team-Based Learning (TBL)

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Improving Patient Safety: Engaging Students in Interprofessional Team-Based Learning (TBL)

Abstract

Complex healthcare systems and ambiguous clinical decisions can result in medical errors which threaten patient safety. There is a need for improved awareness of medical errors across healthcare disciplines. We utilised team-based learning (TBL) to pilot an interprofessional patient safety module for senior health professional students. We evaluated the use of TBL within the interprofessional context to achieve student learning outcomes. Twenty-seven students from pharmacy (n=11), nursing (n=8) and medicine (n=8) faculties participated. Data were collected via questionnaires, focus groups, class observation and student test scores. Quantitative data were analysed using descriptive statistics. Framework analysis was used to code qualitative data using social capital as a conceptual framework. In total, 26/27 (96%) of participants completed the questionnaire and 20/27 (70%) attended focus groups. There was no significant difference in prior knowledge between the disciplines. The TBL module enriched the learning environment and enabled students to prepare, problem-solve and interact with facilitators. The TBL pedagogy and interprofessional framework enabled the development of social capital among students. The module demonstrated the potential of interprofessional education to shift knowledge and attitudes towards a greater appreciation of patient safety issues and better prepare health professional students for the workforce. The TBL pedagogy strengthened knowledge sharing and fostered collaboration across disciplines.

Practitioner Notes

1. Dedicated interprofessional training at the university education level can improve patient safety.
2. The TBL framework enables student learning through preparation, practice, and problem-solving with intra- and inter-team discussion.
3. This patient safety module promoted interprofessional collaboration and examined existing roles, practices, and biases of other disciplines.
4. Social capital is used to describe and understand how individuals benefit from participating in a social network and offers a valuable lens to analyse educational methods.
5. When designing interprofessional case-based activities, care must be taken to ensure the clinical case is relevant to all disciplines.

Keywords

Patient safety, interprofessional, Team-based learning, collaboration, social capital, pharmacy, nursing, medicine

Authors

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Introduction

Globally, avoidable adverse events in hospital result in patient death or long-term pain and disability. In a landmark study evaluating the safety of hospital care for over 14,000 admissions, Wilson et. al. identified that 16.6% of admissions were associated with an “adverse event” resulting in disability or extended stay for the patient.[1] Over half (51%) of the adverse events were preventable, including 4.9% of patient deaths.[1] In Australia, rates of adverse events have remained static or increased.[2] Errors are rarely associated with incompetent healthcare professionals or with inadequate technical knowledge.[1] Situational awareness (human factors), risk communication (information exchange), cultural awareness and poor teamwork are associated with unintentional harm to patients. Understanding the role these factors play in patient care is essential to health professional education.

Healthcare is an inherently interprofessional endeavor and relies on health professionals effectively interacting and communicating with others and the patient. However, interprofessional teamwork remains undervalued in most health professional curricula, resulting in limited shared learning among the different health professions.[3] The journey to competence (fitness to practice) requires students to understand the key pillars of patient safety as outlined in the WHO Patient Safety Curriculum Guide for Health Professionals: teamwork, managing and avoiding error, engaging patients as partners, and leading reform through patient-centered decisions.[4] These principles represent the foundational knowledge and requisite performance necessary for students to practice safe patient care.

With increasing complexity of healthcare systems, there is a need to consider the design and efficacy of interprofessional patient safety education activities. Evidence supports the value of small group peer learning, where participants are engaged and involved.[5,6] Team-based learning (TBL) is a widely utilised educational method across medicine and health education.[6-8] TBL provides an instructional approach for large classes of students to learn in small teams of five to seven students using a student-centred, active learning approach. As a pedagogy, TBL utilises a ‘flipped classroom’ approach, where students attend class prepared to work in teams to solve clinically relevant problems, with learning occurring within and across all teams.[6] TBL is increasingly used as an interprofessional educational platform to strengthen the sharing of knowledge and foster collaboration across disciplines, although challenges remain in its implementation.[9-15]

The current literature suggests that student experiences of interprofessional TBL are generally positive and may help prepare students for future collaborative practice.[10-14] However, there is limited research outlining whether the key elements of TBL can be utilised to support ‘one off’ interprofessional activities within healthcare curricula and the optimal number of disciplines to include.

Our study piloted an interprofessional TBL module on the topic of patient safety: “Understanding and learning from errors” utilising the World Health Organisation Patient Safety Curriculum Guide: Multi-Professional Edition.[4] The module was implemented in 2019 for senior health professional students studying pharmacy, nursing, and medicine within the Faculty of Medicine and Health at The University of Sydney, Australia. During their first two years of their respective programs, all students attended a one-day, large-scale ‘Health Care Collaboration’ event which

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involved working through a patient-based case in teams.

The facilitation of the TBL session within a social network of health professional students prompted us to apply social capital theory to analyse our educational method.[16] Social capital is used to describe and understand how individuals benefit from participating within a social network.[17] By learning ways in which to build social capital within interprofessional learning activities, students may be better prepared to collaborate and invest in real-world interprofessional teams on entering the workforce as health professionals. The characteristics of social capital within the context of an interprofessional TBL include three key attributes:

- **Trust** – the trust that is constructed between learners in interprofessional education groups, as they problem-solve together.
- **Resources** – the clinical cases and relevance across disciplines; the resources that the learners in interprofessional education provide to each other, including individual professional knowledge and skills. [18]
- **Norms and Rules** – the unstated standards that govern actions during the interprofessional education activities, such as individual student contributions to teamwork, and respecting the opinions of all team members.

The purpose of our study was to develop, implement and evaluate an interprofessional patient safety TBL session for senior health professional students. Further, we aimed to explore participants' perceptions of the structure, processes, and outcomes of the session using the conceptual framework of social capital theory.

Method

Course Design

Implemented as an optional component to health sciences curricula, the Patient Safety TBL session was 1.5 hours in duration and delivered on a weekend day to minimise scheduling conflicts. The learning topic was "Understanding and learning from errors", based on Topic 5 of the World Health Organisation Patient Safety Curriculum Guide Multi-Professional Edition. [4] The specific student learning outcomes were to:

- Understand the nature of error within healthcare;
- Understand the ways to learn from error to improve patient safety;
- Explain the terms error, violation, near miss and hindsight bias; and
- Demonstrate the use of "graded assertiveness".

The key principles of our TBL design included: pre-reading (prior to the face-to-face class), an in-class individual test, an in-class team test, immediate feedback and clarification of concepts, and clinical problem-solving activities based around a clinical case.[6]

Compulsory pre-class reading ('internal resources'), with an estimated reading time of two hours, was distributed via email to all students two weeks prior to the session to ensure a similar foundational knowledge prior to the session. The pre-reading included materials relating to patient safety and graded assertiveness[19-21]. Each student also brought their own understanding and knowledge of patient safety, gained through individual and clinical experience, to the session ('external resources').

The in-class schedule included two readiness assurance tests and clinical problem-solving activities. All students were required to complete an *Individual Readiness Assurance Test (IRAT)* at the beginning of class. The IRAT consisted of 10 multiple choice questions (MCQs), with one single best answer for each question. The test was based on the prescribed pre-reading and designed to assess each students

understanding of patient safety. Students were provided with 10 minutes to complete the quiz on paper by circling the correct answer. The quizzes were collected at the end of the session. Students were not shown the correct or incorrect responses to the questions.

The same 10 MCQs were then repeated in the *Team Readiness Assurance Test* (TRAT) undertaken by students in their teams. The test was administered using one scratch card per team, with the intent of promoting discussion to establish team consensus. If a team answered the question correctly on the first attempt, they received a score of four, and each time they reattempted an answer, they would lose one mark. The scores for each question were summed to obtain a total score ranging from 0 to 40. The correct answers were then explained after each question, giving immediate feedback on team responses. The facilitators offered clarification, particularly where individuals or teams had experienced difficulty answering the questions. Students had the opportunity to interact with the facilitators and challenge answers.

Students were then provided with a clinical scenario which highlighted errors in patient care, including errors in communication, teamwork, supervision, workplace culture and the hospital environment. The case was conceptualised by a clinician, an expert in patient safety, and an educationalist. It was reviewed by two clinical academics from nursing and pharmacy. The case formed the basis of further problem-solving activities within the TBL session. Students consolidated the knowledge obtained in the previous steps to create a mechanistic flow chart of the errors in patient safety in their teams. Team members were selected by the facilitators to ensure an even distribution of students from each discipline within a team. In the class of 27 students, there were five teams, with five to six students per team. The TBL was co-facilitated by two academics: a Physician-in-Training, and a Professor of Medical Education, Patient Safety. Facilitators provided immediate and accurate feedback to individuals, teams, and the class. Figure 1 outlines the structure of the TBL.

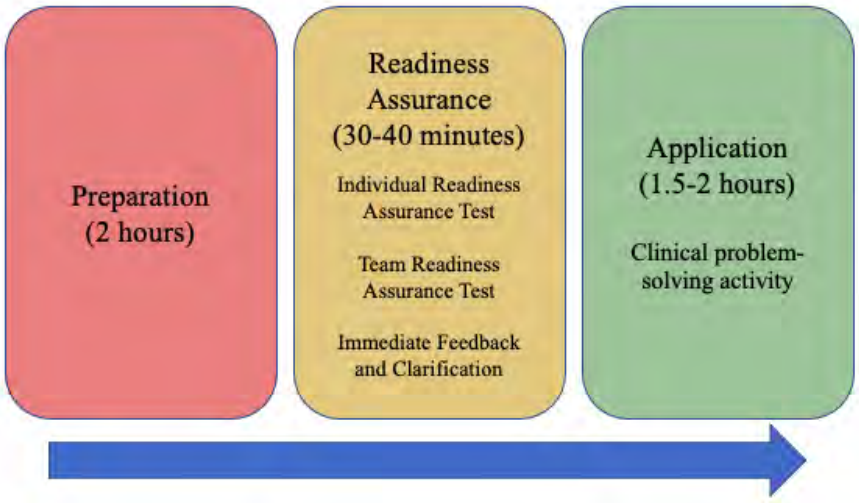

Figure 1*: The specific steps of the TBL with suggested time frames, adapted from Burgess et al., 2020* [22].

On completion of the module, participants received a certificate of completion.

Study design

Recruitment

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All senior health professional students from pharmacy, nursing, and medicine already engaged in an optional peer teaching course were invited via email to participate in the patient safety TBL session.

Data collection and analysis

Questionnaire

Students were asked to complete a questionnaire immediately after the TBL session (see supplementary material). The questionnaire included 18 closed items, using a five-point Likert-scale, ranging from 'strongly disagree' (1) to 'strongly agree' (5). The quality of team processes was measured using items adapted from a validated questionnaire designed by Thompson et. al.[23] In addition, attitudes towards interprofessional learning were measured using items from the Readiness for Interprofessional Learning Scale (RIPLS).[24] Quantitative data were analysed using descriptive statistics.

Focus groups

All students were invited to attend focus group sessions at the end of the TBL session. The focus groups were facilitated by two educationalists (AB & CvD) and took the form of semi-structured interviews around a set of pre-determined questions (see supplementary material). The transcript was recorded and transcribed verbatim. Following consultation with all authors, the first and second authors (AJC and AB) used framework analysis[25] to code the dataset using social capital theory as a conceptual framework.[25]

Observation

Observation of the teaching session was undertaken by two senior academics JB (a Registered Nurse), and CS (both a Pharmacist and Registered Nurse). They observed student engagement throughout the TBL session, including intra- and inter-team engagement (team test, feedback, problem-solving activities), and student interactions with the facilitators.[26]

Test scores

Test scores from the IRAT and TRAT were recorded. The scores for questions within the TRAT were summed to obtain a total score ranging from 0 to 40 for each team. The mean IRAT scores between disciplines were compared using one-way analysis of variance (ANOVA). Data were analysed using IBM SPSS Statistics, version 27.0 (SPSS Inc., Chicago, Ill., USA).

Ethical considerations

Ethics approval for the study was granted by The University of Sydney Human Research Ethics Committee.

Results

Twenty-seven senior students from pharmacy (n=11), nursing (n=8) and medicine (n=8) voluntarily participated in the interprofessional patient safety TBL session.

Questionnaire

In total, 26/27 (96%) of participants completed the questionnaire, 10 pharmacy students, eight nursing students and eight medicine students (10 male, 15 female and one unstated). Student responses to closed items regarding their experience of the TBL are displayed in Figure 2. Overall, students responded positively to items relating to the quality of team processes and contribution of team members (items 1-5). Responses also indicate that the steps in TBL were valued by the students, including pre-preparation, IRAT, TRAT, problem-solving (items 7,11,12); as well as the feedback and interactions with the facilitators (items 6,9,10). All students valued the interdisciplinary context of learning, with 100% of students strongly agreeing or agreeing that "*[h]aving team members from different disciplines enhanced my experience of peer learning*" (Q8), "*[s]hared learning with other*

healthcare students increased my ability to understand the concepts of this topic" (Q13), and "*I would welcome the opportunity to again learn with other healthcare students*" (Q17). Almost all students disagreed with the statement that "*[i]t is not necessary for healthcare students to learn together for this topic*" (Q14).

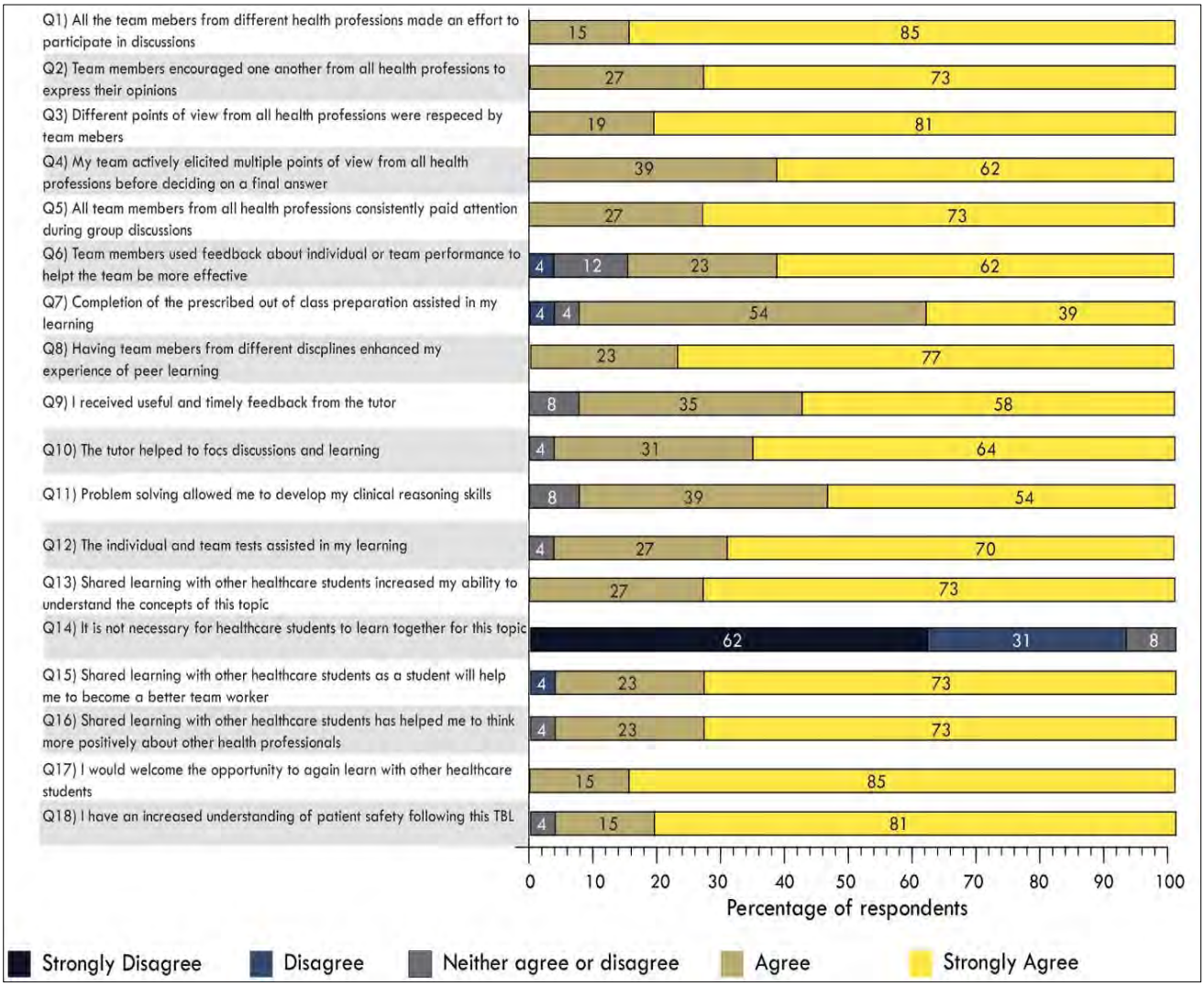

Figure 2: *Student responses to closed items regarding their experience of the TBL.*

Focus groups

Twenty students (74%), including eight medical students, six pharmacy students and six nursing students, attended one of two focus groups sessions. Qualitative focus group data is presented in Tables 1, 2, and 3. The results are presented within the conceptual framework of social capital theory. Whilst there is overlap in the three key attributes of social capital, each theme reflects different stages of social interaction and learning within the interprofessional TBL context. The theme of 'Trust' is presented in Table 1; notably, students felt the session emphasised the need for shared patient care and helped them to develop an appreciation and understanding of the roles of other disciplines. The theme of 'Resources' is presented in Table 2; students valued the knowledge and skills that individuals from each discipline brought to the session and the structured frameworks provided. The theme of

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‘Norms and Rules’ is presented in Table 3; students found the TBL format helped to promote respectful inter-disciplinary discussion among students.

Table 1. *Participants' perspectives in relation to the theme of 'Trust': the trust that builds within a social network.*

Theme: Trust	**Example quotation**
The session helped to develop rapport and respect for other professions.	*I definitely think this helps to build respect for other professions, and rapport as well.*
The session emphasised the importance of shared care patient care.	*Not just that respect for other professions, but also better care for the patient because it's, like I'm not the only one responsible for this patient, there are so many other people working together collaboratively … to increase their care and their outcome.*
Students developed their appreciation and understanding of the roles of other disciplines.	*When you're doing… a four-year degree (pharmacy), you kind of get stuck in it and you think, you're solely responsible for that patient, but then you come to group meetings like this and you see what everyone else does and what they've learned, what they bring to the table.* *I personally really like [working with different disciplines] just to see… the different opinions and how we … we know about the topics but we tackle it in different ways and I thought that was …really interesting…. Pretty cool.* *I always think that it's good to actually get these sorts of interdisciplinary activities in the degrees because if everyone's doing their own thing and we all graduate, it's harder once we all reach the workforce and then we're all like…. I didn't know you do that, didn't know nurses do that, I didn't know pharmacists do that. But it's so much easier when you start it early in the degree… and so then everyone is already prepared and everyone already has… a respect for each other and that will just keep going out of the degree and into when everyone just starts working together.*
The TBL format helped to develop promote discussion and trust among the disciplines. During the tests and problem-solving activities, students were respectful of others' opinions.	*Everyone voiced their opinions (during the test) and I feel like everyone was very receptive to each other's perspectives because being from different fields we would have different experiences in the workplace so I think it was good that we were all able to share that and go, I wasn't aware that your role involves this or from the perspective of that so, I feel like everyone was very open to listening.*

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Table 2. *Participants' perspectives in relation to the theme of 'Resources': the resources that a social network offers to its members.*

Theme: Resources	**Example quotation**
Students valued the knowledge and skills that each discipline brought to the group. Gaining a better understanding of other disciplines helped students to understand how they can work together as a team.	*I think it was an eye opener because when you're studying within your degree you're only learning from one perspective so for me I'm only learning from the pharmacy perspective, then when we all came together it was an eye opener in that, oh, this is what the medicine people do, this is what the nursing staff do, and it just brought all the theory that we've learnt over the degree into the one place – I thought that was pretty interesting, so we can tackle the patient care all as a team rather than – on your own, you're always together, you can bounce ideas off other people with other educational backgrounds.*
Students found it useful to be provided with resources about the theory and evidence behind patient safety prior to engagement in the TBL session.	*The theory was helpful in terms of what's an error, what's a violation, what's a slip, what's a lapse. I think when we did it in the – in the context of what are factors that lead towards these issues, like, we talked about I think it was HALT – Hungry, Angry, Late, Tired… the 'I am safe acronym' – when you are in those states you might also think I – I'm more prone to forgetting things or I'm more prone to, maybe doing something in the heat of the moment especially when I know it's wrong….The first type of solving problems when you actually realise that you have a problem, or admitting it.*
Students valued understanding structured frameworks offered that may be applied in the workplace, such as graded assertiveness.	*I think the format that you did provide, the CUSS [acronym] …. For graded assertion …. That helps because there's a little bit of …. Structure for if you go ahead and say to a consultant, "Hey, I think you're making a mistake." So, I guess, it, kind of works that way but there's still that, sort of, hierarchy.*
Through use of an authentic patient case, students felt they gained an insight into other disciplines that was relevant for the workplace.	*I feel like I got to gain a lot more insight into the other fields, for example, that it actually takes a while for a doctor to write down the dosage regimen and so I feel like I could take that into the workplace and be able to understand the other fields a lot better.*

Table 3. *Participants' perspectives in relation to the theme of 'Norms and Rules': the implicit values that govern members of a network.*

Theme: Norms and Rules	**Example quotation**
The session gave students an awareness of patient safety in the workplace, and how to be compliant with the systems and rules.	*I think it helped me understand that you're now more aware where errors can go wrong because it is such a long process, you're more aware of how you can actually help to prevent that.*
Students felt they were more aware of how to minimise error, and think prospectively, and importantly, how to learn from mistakes to improve future outcomes.	*It's important that we look at things prospectively and try to minimise as many things as possible, but it's also a matter of, if something does happen, that we do know, what to do in regard to that particular error and how can we possibly add things to the system or amend things in the system to make sure it doesn't happen again.*
Students also felt the TBL session provided them with knowledge and communication techniques to better prepare them for the workplace.	*When I start working next year it'll … give me an idea of points in a particular process … where there might be issues and maybe checking up on those points. So even if it's with charting medication, especially if it's medications that I'm not normally charting, then what can be the issues with that in terms of the actual dose, but then also the patient to whom I'm applying it, and then as it goes through nursing and then if pharmacy gets involved as well, what are the pressure points there and so going from …me charting it to the patient receiving it, just checking those points, prospectively rather than retrospectively when the damage can potentially have already been done.*
Students emphasised the need for embedding interprofessional team activities within the healthcare curricula rather than as additional, voluntary activities.	*Because most of this stuff [interprofessional activities] is usually voluntary… we don't get a lot of team building things. I think it should be integrated… in all health care degrees because I feel like a lot of people can get so stuck in their own occupation that they forget that… you've got all these other people that you're meant to be working with and then, it's almost a lack of respect with some people and I think by doing this sort of exercise you do get to see people other than those from your own occupation because in the real world you do have to get along with everyone else.*

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Observation

The students' positive perception of the structured TBL method as a learning tool was cross validated by the observations. Student engagement demonstrably increased when completing the TRAT within their teams. The use of scratch-cards introduced a degree of competition, aiding further discussion. Students also appeared to derive confidence from their consensus decision-making, which stimulated student dialogue with facilitators when the appropriate answers were provided during the feedback stage. Facilitators were able to clarify patient safety concepts as they arose directly from students and teams. Observers noted that students were most engaged when facilitators provided real clinical examples and anecdotes from their personal experiences during the clinical problem-solving sessions, including both negative and positive outcomes. Openly sharing examples of practices within the clinical and hospital environment was another way facilitators engaged student interest. The observers noted that students enjoyed interacting with others within their team, as evidenced by the level of conversation, enthusiasm to participate and collective focus on the required tasks. Students were noted to particularly value the opportunity to participate in the clinical scenario tasks, and a willingness for each team member to take turns to provide input was observed. Notably, students demonstrated respect and positively framed critique when providing individual feedback about each team member's performance and contribution.

Test scores

Mean IRAT scores for the disciplines were 60.00% (nursing, n=8), 60.27% (pharmacy, n=11), and 70.00% (medicine, n=8). A one-way ANOVA found no evidence of a significant difference in mean scores between disciplines ($F=0.865$, $df=2$, $p=0.43$), suggesting that the knowledge base was similar across attendees. Across the mixed discipline teams, TRAT scores ranged from 31 to 35 out of 40.

Discussion

We sought to explore senior health professional (pharmacy, nursing, medicine) students' perceptions of their learning experience of the Patient Safety topic: *"*Understanding and learning from errors*"*, delivered using TBL format. Both quantitative and qualitative data indicate that participants found the interprofessional delivery of the patient safety session key to its success. Student understanding of patient safety was facilitated by the TBL framework; it enabled students to prepare, practice through testing, problem-solve through intra and inter-team discussions and interact with the facilitators. We used social capital theory to further characterise students' learning experience within the interprofessional TBL.[17] These key elements have been summarised in Figure 3 and are discussed below.

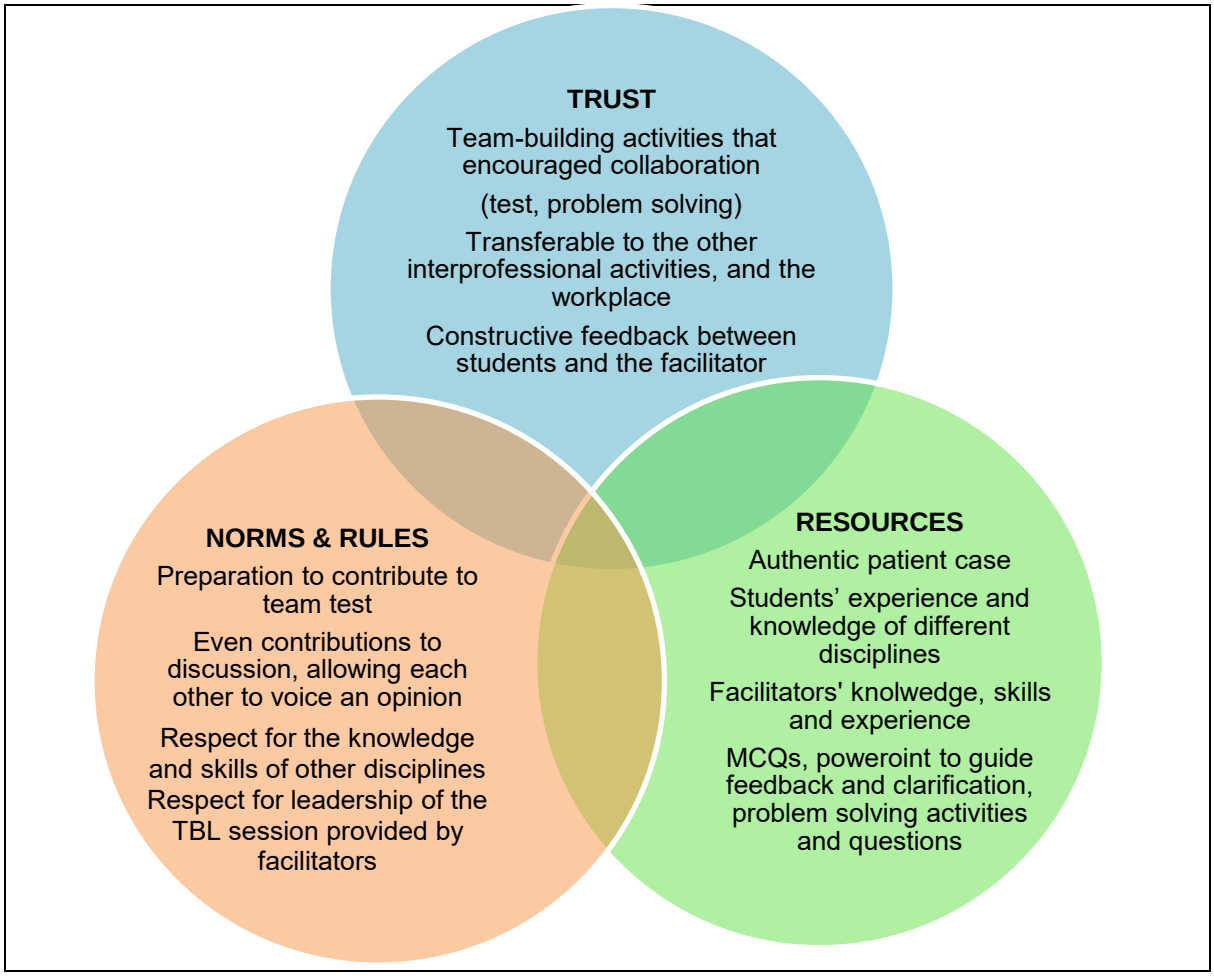

Figure 3: ***E****lements specific to the interprofessional patient safety TBL that were identified as key to the development of social capital.*

Trust

Students were required to rely on their peers' contributions to team tasks to complete the TRAT and then engage in discussion about the clinical case. Responses to the closed questionnaire items relating to the quality of team processes, including interprofessional collaboration, were positive. Focus group results indicated that students valued the development and promotion of interprofessional trust. A

significant barrier to interprofessional collaboration is deficiency in the understanding of roles and practices of other disciplines and existing biases.[27] This educational module provided a positive experience that may encourage students to reinvest in future interprofessional collaborations, both during their studies and in the workforce. Similar findings were reported by Chan et. al., where 801 health professional students from across six healthcare disciplines participated in a 'one off' interprofessional TBL session, resulting in a significant improvement in their attitude towards interprofessional learning and their readiness to engage in future interprofessional activities.[13]

Resources

Student responses indicated that the TBL format of the class provided a clear structure to the session. The key internal resources were those within the TBL module, including the pre-reading, the readiness assurance test, as well as the patient case and related problem-solving activities. Qualitative feedback indicated that the real-life frameworks used, such as graded assertiveness, were elements that would be useful in the workplace. External resources included the knowledge that each student brought to the session specific to their discipline. Additionally, facilitators brought not only their professional knowledge and skills, but also their teaching skills to the TBL which allowed for immediate and accurate feedback to individuals and teams. Students valued learning about the perspectives of each discipline. A willingness of members within a social network to offer assistance within the team structure is key to success.[28] During the TBL, students willingly shared their knowledge and experience, and communicated effectively with each other and the facilitators, checking comprehension. Importantly, students felt that the TBL session and the development of similar interprofessional patient safety learning activities would ultimately contribute to better patient care.

Importantly, IRAT results from across pharmacy, nursing, and medicine support that all three disciplines had a similar level of base-knowledge in order to contribute to class activities. Furthermore, the mixed discipline teams performed evenly. In a previous interprofessional TBL study on the topic of patient safety and ethics, involving 639 students from across 10 healthcare disciplines, there were significant differences between the IRAT scores of some disciplines.[12] Similar difficulty was encountered by a TBL study involving 39 senior students from across five healthcare disciplines[14]. Our results suggest it may be beneficial to have fewer disciplines (three or four, rather than 10) involved in a single interprofessional TBL to make curriculum alignment more manageable and the clinical case for discussion inclusive of each discipline[15].

Norms and Rules

As outlined by Hean et. al., compliance or non-compliance with norms can either restrict or facilitate individual and group action.[17] Students commented that team members were respectful of the opinions of different disciplines, and *"receptive to each other's perspectives*", recognising that individuals *"have different experiences in the workplace".* As reflected in the IRAT results, most students attended prepared and ready to engage in discussion, and did not 'freeload' during the session, as is sometimes reported in small group learning.[29] Within and beyond their teams, students felt their knowledge and contributions were valued by those from other disciplines. The three disciplines felt able to contribute to the problem-solving activities, and students reported that provision of an authentic patient case helped them to understand each other's roles and their joint responsibilities.

Study limitations

We had a small sample size of 27 students in this pilot study. Participation was voluntary, which has the potential to limit the representativeness of our results, with those attending potentially more engaged

in learning from different professions. A mixed methods approach, however, gave rich insight into the student experience.

Conclusion

Dedicated interprofessional training at a pre-vocational level can achieve improved patient safety outcomes at the healthcare institution level. Our study provides an effective and scalable interprofessional framework to assist development of social capital among health professional students. The interprofessional TBL was valued by pharmacy, nursing, and medicine students, providing a useful approach to teaching patient safety. Moreover, the interactive TBL format helped to maximise the social advantage of interprofessional group learning. Students' test results across three disciplines suggest a similar level of prior knowledge and appropriate curricula alignment on the topic of patient safety. Participation in the program has the potential to shift knowledge and attitudes towards a greater appreciation of patient safety issues, and better prepare our health professional students for an interdisciplinary workforce.

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