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Development of self-regulation amongst dental students in problem-based learning curricula: A qualitative study

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Abstract

Aims: To explore the value of problem-based learning in the development of self-regulation amongst undergraduate dental students.

Materials and Methods: A qualitative approach using focus groups was used to explore the perceptions and experiences of the participants regarding the role of problem-based learning (PBL) in promoting self-regulation in undergraduate dental education. The study was carried out at a newly established dental institution in Qatar. Purposive sampling technique was used to recruit the participants. Invitations to potential participants were sent by e-mail through appropriate professional channels. All focus groups were transcribed verbatim, and data were imported into NVivo 12 and analysed thematically.

Results: A total of five focus groups were conducted with 37 participants which included 27 females and seven males from two different cohorts. Participants expressed their views on a range of issues related to the self-regulation in problem-based learning and also provided recommendations to enhance the learning experiences of students. PBL was perceived to be an appropriate and effective strategy to support student autonomy in construction of knowledge and developing problem-solving and interpersonal skills. However, the workload of the students can impact adversely on their motivation and time management skills.

Conclusions: This study provides useful insights into the concept of self-regulation in problem-based learning environments as perceived by the stakeholders at a newly established dental institution. The findings of this study may offer clarity on how problem-based learning can be best utilised to promote self-regulation in undergraduate dental education.

KEYWORDS
dental education, problem-based learning, self-regulation, undergraduate

1 | INTRODUCTION

Dental professionals are expected to demonstrate clinical problem-solving and decision-making to provide effective patient care. In addition, the dental regulatory bodies require dental professionals to maintain and develop their knowledge and skills through lifelong learning by engaging in continuing professional development activities.[1,2] These requirements are not unique to dentistry but mirror those in other healthcare professions like medicine, nursing, etc. Research in medical education is placing an increasing emphasis on self-regulated learning (SRL) skills to enable healthcare professionals to achieve these objectives.[3]

Self-regulation is the ability of the learners to set, plan and achieve the academic goals by adapting their motivational, behavioural and metacognitive aspects of their learning.[4] Self-regulation is not a single trait but involves a combination of processes whereby the learner adapts to complete specific learning tasks including: (i) setting specific proximal goals; (ii) use of powerful strategies to achieve these goals; (iii) monitoring performance to evaluate progress; (iv) aligning one's physical and social context with personal goals; (v) effective time management; (vi) self-evaluation of learning; (vii) association of methods with results and viii) adaptation of future methods.[5]

Growth in medical knowledge and technological advances in healthcare professions are progressing at a rapid pace which further underscores the need for SRL. Development and evaluation of SRL skills need to start during undergraduate education to allow a smooth transition of graduates from the spatial and temporal confines of the university into their clinical careers.[6]

Problem-based learning involves active student learning, and development of problem-solving skills through self-directed learning (SDL). As described by Knowles, "A self-directed learner takes responsibility for their own learning and has internal motivatio our presentatin to develop, implement, and evaluate their approach to learning".[7] The need for autonomy and self-regulation has contributed to the increasing use of PBL in medical education.[8] PBL may support development of clinical reasoning, team working and deep learning.[9] PBL also enhances students' satisfaction, motivation and encourages them to take responsibility of their learning through SRL. Research on medical students and trainees shows that SRL skills developed during undergraduate education are critical in helping students develop autonomy which is essential for lifelong learning following graduation.[3,10,11] However, there is limited published literature on SRL in PBL-based dental curricula and this merits further research.

The aim of this study was to explore how the dental students perceive development of self-regulation in a PBL environment at a newly established undergraduate programme.

1.1 | Conceptual framework

Dental education occurs in a variety of learning environments including classrooms and small group settings such as PBLs, workshops, dental simulation laboratories and clinical settings. Learning requires authentic situations and activities and is intricately tied to its context.[12] The dental profession represents a professional community that come together in pursuit of a shared enterprise. New entrants to undergraduate dental programmes commence their learning journey at the periphery of the dental community which is akin to legitimate peripheral participation.[13] However, unlike a traditional apprentice whose learning may be limited to observation and imitation, dental students are expected to actively participate in acquisition of knowledge, clinical competence and behaviours through social interaction with the community.

The theoretical framework of this study was informed by self-determination theory (SDT), which focuses on motivation of learners for intentional self-development.[14] The SDT is based on three core needs of learners: (i) *the need for autonomy*, (ii) *the need for competence* and (iii) *the need for relatedness*. Students require epistemological agency to optimise their learning and facilitate their positioning and engagement in learning environments for meaningful learning experiences.[15] The principles of SDT are being applied increasingly in medical education as self-regulation allows learners to regulate their own behaviours even if the origin of the regulation is external or is partially internalised.[16]

2 | METHODS

2.1 | Setting and institutional context

The study was conducted at College of Dental Medicine, Qatar University. It is the first dental institution in the State of Qatar and the first cohort of undergraduate dental students was recruited in 2019. The dental programme has a duration of 6 years (full-time) and is based on a contemporary, problem-based and student-led curriculum. PBL sessions based on real patient cases allow students to construct knowledge by developing SDL skills and collaboratively solving problems. Faculty support student learning by signposting them to relevant topics in lectures and tutorial sessions. PBL cases in Year 2 are based on medical problems whilst the Year 3 PBL cases involve a combination of medical and dental problems.

The PBL cases are structured to encourage students to integrate biomedical knowledge with behavioural, social, ethical and biopsychosocial approaches to patient care. Each PBL case runs over 1 week, and the student groups come together in two sessions lasting 3 h. During the first session, at the start of the week, the students are presented with a clinical case and the patient journey through various stages, that is, clinical presentation, diagnosis, treatment planning, treatment delivery and follow-up, which are structured using a series of triggers. The students work together to identify their learning objectives for each trigger and deliberate on various aspects of the case. During the next 3 days, they prepare student-led presentations; draft concept maps to demonstrate clinical problem-solving; and critique a published research article related to the clinical scenario. These are presented in the second PBL session at the end of the week.

Acquisition and sustainability of biomedical and applied clinical knowledge are assessed throughout the academic year using summative quizzes and end-of-semester assessments based on single best type multiple-choice questions. In addition, evaluation of the students during PBL cases contributes to 10% of the final summative grade. Interprofessional education (IPE) is an integral part of the curriculum and dental students participate in joint learning sessions with students in medicine and allied healthcare educational programmes. IPE summative assessments carry a weighting of 5% in the final student grade. Self-reflection is embedded throughout the curriculum and students write two reflective reports which carry a weighting of 10% in the summative assessments. The PBL model used at our institution is supported by a combination of reflective, independent and collaborative learning as depicted in Figure 1. Students develop their practical skills in a fully digitalised dental simulation laboratory whilst clinical training is provided in both primary and secondary care settings at multiple sites.

2.2 | Study design

Qualitative methods using focus groups were used for this research.

Sampling technique PBL at our institution is introduced in Year 2 and continues in subsequent years. Current Year 3 represents the inaugural cohort at our institution. Purposive sampling technique was employed to recruit dental students (DS), in Years 2, and 3 of the undergraduate programme.

Following approval by the institutional Research Ethics Committee, recruitment of the participants was carried out through e-mails using appropriate professional channels.

2.3 | Data collection

A topic guide was developed to guide the course of the focus groups. The topic guide consisted of a few leading, open-ended questions to gauge the perceptions and experiences of the participants during PBL sessions. The research lead briefed the moderators of focus groups regarding the scope and purpose of the research. Regular follow-up meetings and email correspondence were maintained with the moderators to answer their ongoing queries prior to the focus groups.

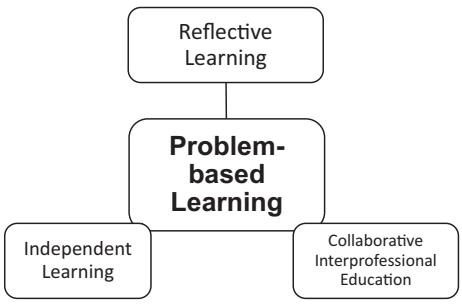

FIGURE 1 Problem-based learning model supported by reflective, independent and collaborative learning

Five focus groups were conducted in quiet rooms at the university premises for each group separately. A mutually convenient date, time and location were worked out with each group. The research team obtained a written informed consent from each participant including audio recording of the focus group discussion prior to its commencement. The professional capacity and role of the focus group moderators were made clear to the participants prior to conducting each session that is, the moderators are full-time faculty members at College of Dental Medicine. Participants were reminded that the proceedings of the focus group would follow the Chatham House rule to protect the anonymity of the participants.

Participants had complete freedom to express their views and interact with other participants in their group and the moderators only facilitated the course of group discussions. The moderators recorded their reflections about the focus group interactions on paper immediately after each of the interviews to capture their observations. The focus groups were recorded and transcribed verbatim by each moderator within 2 weeks. The accuracy of the students' focus group was checked with the moderator hosting the group immediately after transcription. Member checking was done to confirm the accuracy of electronic transcripts with the participants prior to data analysis.

2.4 | Data analysis

The data were analysed in NVivo 12 (QSR International Pty Ltd) using thematic analysis with an inductive approach.[17–19] The approach to data analysis was aimed at situating SRL within the narratives of stakeholders emanating from their understanding, experiences and expectations. Data analysis focused on capturing the context and meanings of the rich imagery and storytelling shared by the participants.

Systematic reading through the entire data set, sentence by sentence, was carried out for an initial coding of the data. Each element of the transcripts was categorised to reflect the views of the participants. Initial coding of the data identified 64 nodes, which involved grouping similar and repetitive ideas expressed by participants. Repetitive revisiting of the transcripts, audio recordings and the accompanying notes helped to collapse the nodes into broader codes.

Further analysis and reflection helped to establish linkages between nodes, which facilitated development of *tree nodes* from *free nodes* and ultimately helped shape the themes. The *tree nodes* were developed within the N Vivo software and effectively linked coded categories of data and helped map connections within the data.

A thematic analysis of the data was carried out using an inductive approach, that is, the themes were data driven and were not categorised based on the topic guide used for this research. Thematic analysis was used to identify broad areas, which captured the views and experiences of the participants. The tree nodes with a parent node were used to identify the branches (free nodes) which were

contributing to a given theme. Segments of verbatim quotes from different participants were incorporated as coded text to provide the contextual material supporting different themes.

Member checking was done with two independent researchers to verify the seeming accuracy of the category system. Consensus on themes amongst the research team required minor modifications to coding following deliberations. The results were shared with one member from each focus group to ensure interpretation of the data was consistent with their views.

3 | RESULTS

A total of 34 participants (27 females and seven males) from two cohorts of undergraduate dental students participated in focus groups. The demographic profile and distribution of the participants across five focus groups are summarised in Table 1.

Participants expressed their views and experiences of PBL and shared their perceptions regarding the impact of PBL on the development of SRL. The main themes related to the impact of PBL settings include prior learning experiences to facilitate student transition into the learning environment; student autonomy and dental relevance to learning activities to enhance intrinsic motivation; boosting self-confidence by consolidating interpersonal skills and reflective practice to enhance self-efficacy. Each theme is discussed in this section along with excerpts from focus group transcripts.

3.1 | Learning environment

This theme related to prior exposure of the participants in various learning environments. All participants had prior experience of delivering student-led presentations in Year 1 whilst some had also participated in project work in their high school. However, they did not have any exposure to PBL, and most participants found it challenging to adapt to this mode of learning. Although students were given an introductory session on PBL in Year 2, most students needed several weeks to acclimate for effective participation in PBL sessions.

> I did not have any prior experience of problem-based learning, I wasn't confident and found it difficult to adjust initially… but I like it now and feel PBL is more enjoyable than listening to lectures all the time!
>
> (Student 4, Year 2).

The participants viewed PBL positively and considered the learning environment to be welcoming and non-threatening. However, most participants underscored the need for a structured induction programme to allow a smooth transition of students without any previous experience of PBL. Lack of prior experience of the participants indicates they need more support and time to develop SRL.

> I feel that PBL started somewhat abruptly and a structured induction to PBL would be very helpful to allow us to become familiar with this model of learning and provide us with a firm ground to build our learning journey
>
> (Student 2, Year 2).

3.2 | Autonomy

This theme related to the perceptions and experiences of participants regarding independence in their learning journey. The participants valued the opportunities to actively participate in their own learning to construct knowledge and apply it to clinical problem-solving and treatment planning of patient cases in PBL sessions. Students also valued opportunities for self-directed learning as it enhanced their confidence to search authentic sources of information. Participants were unanimous that PBL had a positive influence on their learning experiences and increased their sense of responsibility. PBL was reported to enhance student motivation and it encouraged them to regulate their self-directed learning rather than merely being passive recipients of information in lecture settings.

> PBL gives us opportunities to take control of our learning and I like to solve clinical problems discussed in the PBL cases and connect the dots…I feel it would help us on clinic to diagnose our patients
>
> (Student 8, Year 2).

However, the participants shared their concerns that some PBL facilitators were too prescriptive in their approach, and it amounted

TABLE 1 Demographic profile of participants

Focus Group No.	No. of participants (*N*)	Gender		Stage
		Females (*N*)	Males (*N*)	
Focus Group 1	7	7	-	3
Focus Group 2	9	7	2	2
Focus Group 3	4	3	1	2
Focus Group 4	7	5	2	3
Focus Group 5	7	5	2	2
Total	34	27	7	-

to curtailing their freedom during the PBL sessions, especially during formulation of the learning objectives. Also, a considerable variation was reported in the experience and expertise of the facilitators.

> Last semester my facilitator was brilliant and gave us plenty of time to formulate our learning objectives but this year the facilitator interrupts us time and again and does not encourage discussion
>
> (Student 9, Year 3).

Participants also expressed some reservations regarding the quality of feedback by the facilitators as the student expected frequent and structured feedback following each PBL case. Participants felt additional training and calibration of facilitators would be helpful to ensure a consistent experience for students in different PBL groups.

3.3 | Relatedness

This theme related to the context, relevance and application of knowledge to clinical dental problem-solving. Participants, particularly those from Year 2 cohort, felt that the medical content in the PBL sessions was too heavy and not always relevant to dentistry. Although attending medical resource sessions with their peers in the medical programme was perceived to be beneficial, participants across the board expressed their preferences to see more dental context in the PBL cases so that they could relate it to their future role as a dentist.

> There is too much medicine in the cases, and I am not sure if we need all that depth in DENTISTRY, make me wonder if I am training to be a medical doctor instead of a dentist
>
> (Student 7, Year 2).

> In Year 2, the PBL cases were medical problems and I found it really difficult to relate to them, this year there is a bit more dental context, but the medical content is still too much
>
> (Student 6, Year 3).

3.4 | Interpersonal skills and collaborative learning

This theme related to participants' perceptions regarding acquisition and development of communication skills in a PBL environment. Participants across the board expressed that PBL had a positive impact on the development of their interpersonal skills which enhanced their self-belief and confidence. PBL was perceived to be helpful in developing communication and presentation skills as well as a useful platform to demonstrate professionalism and mutual respect.

> Doing regular presentations in PBL with my peers has really boosted my confidence and I am no longer shy to act as a group leader and moderate the session—communication skills are very important for a dentist and PBL sessions have been very helpful
>
> (Student 11, Year 3).

However, some participants felt shy to give any negative feedback to their peers as it might adversely affect their assessment grades for the PBL. Similarly, some participants were reluctant to ask too many questions on presentations given by their peers for the same reason.

> I would like to ask questions to my peers during their presentations, but I fear that if they are unable to answer, the PBL facilitator might lower their grade
>
> (Student 1; Y2).

PBL was perceived to be a useful platform for collaborative learning and developing team-working skills and none of the participants reported any conflicts within their PBL groups. However, majority of the participants felt that outside the PBL sessions, communication within the group members was limited to dividing the workload and assigning specific tasks to individual group members. Time constraints made it difficult for group members to come together prior to the final session.

> We have a WhatsApp group and use it to divide the presentations, concept map and research, we are too busy to meet on campus to discuss the case and plan our next session
>
> (Student 5, Year 2).

3.5 | Time management.

This theme related to the views of the participants on challenges related to time management and their academic workload. Time management was perceived to be the biggest challenge by all participants and was largely related to the workload of the students. Challenges related to time management was one of the strongest themes in all focus group discussions. Both cohorts participated in two 3-hour PBL sessions per week. In addition, they attended 12–15 h of resource sessions by medical and dental faculty per week along with other academic commitments. Participants felt the workload related to PBL sessions, that is, preparation of their presentations, drafting concept maps and exploration of relevant research articles, was overwhelming and did not allow them adequate time for self-reflection as they were fatigued by the end of the study week. Participants also found it difficult to complete their presentations and discuss the concept map and related research during the second session of each case.

> There is always too much to do for our PBL cases, we have 2 sessions each week and only get 3 days to complete our presentations and concept map, and then you also have to present a research article. it is

> very tiring, and I have little time to sit down and reflect on my own performance
>
> (Student 16, Year 2).

Participants across the board agreed on the need to reduce the workload related to PBL cases by reducing the number of topic areas covered by individual PBL cases, particularly the medical content which is not directly relevant to dentistry. Participants felt this would enable them more time to dissect the patient cases in great depth and also allow more time for SDL.

> I wish there was only one PBL session at the start of the week and we could have until the next week to complete all the tasks, may be also have more dental stuff in the cases, it will keep us interested
>
> (Student 14, Year 2).

In summary, PBL was perceived to be an appropriate model to support self-regulation of undergraduate dental students. PBL can be used to promote student autonomy in construction of knowledge and development of problem-solving and interpersonal skills. However, the dental context of the PBL cases needs to be enhanced to improve relatedness for dental students. Also, the workload of students can impact adversely on their motivation and time management skills. The responses by the participants also highlighted areas requiring improvement including: a structured induction of all new students into PBL environments; and further training of PBL facilitators to provide a uniform learning experience for students in different PBL groups.

4 | DISCUSSION

The terms SRL and SDL appear to share some commonalities and are sometimes used interchangeably. However, it is important to recognise that SDL indicates a general approach to learning adopted by a learner to take responsibility of their learning. On the other hand, SRL is a dynamic, context-specific strategic learning process which involves microanalysis.[20] SRL involves use of a variety of cognitive and metacognitive processes to achieve intended learning. SRL hinges on increasing their self-efficacy beliefs, self-monitoring of the progress of selected goals and making adaptive changes to goals and motivational and attribution beliefs.[4]

PBL is now well established in contemporary dental undergraduate programmes.[21–23] However, to our knowledge no previous studies have explored the value of PBL in self-regulation of dental students. Nevertheless, research in dental education has highlighted the need for enhancing intrinsic motivation of students to foster autonomy and self-regulation.[24,25] This study underscores the potential value of PBL to promote self-regulation amongst dental students. PBL offers numerous opportunities to develop student autonomy and self-reflection to enhance intrinsic motivation and self-efficacy in the face of academic workload and time pressures. However, the participants identified several areas in need of improvement to enhance the learning experiences of the students. Our findings partially corroborate with previous studies on medical students which show that, although students enjoy PBL, the gains in learning can vary depending on the structure of PBL curricula and institutional culture.[26]

One of the key recommendations by the participants was focused on the need for further training for PBL facilitators. Participants in this study reported a variable experience with PBL facilitators ranging from excellent to poor. Criticism of PBL facilitators primarily focused on their prescriptive approach which limited student autonomy and the quality of feedback to students. These findings are consistent with previous studies on medical students as PBL only works with small groups of students which makes it resource intensive.[27]

The perceptions of the students may reflect the heterogeneous experiences of PBL facilitators at our institution which include a mix of experienced faculty members as well as those with limited previous experience of PBL facilitation. Moreover, individual approaches to facilitation can vary due to diverse PBL practices in previous institutions of the facilitators. It is also possible that conflicts between facilitators' practices and pedagogical beliefs may influence their quality of facilitation. It is recognised that pedagogical beliefs of university teachers may take a long time to change.[28] Therefore, it is paramount to provide further training to PBL facilitators to ensure consistency in facilitation practices, particularly at a newly established institution. Organising professional learning activities for PBL facilitation using a systematic approach is required to support all faculty regardless of their experience level. A community of practice approach by involving educators who can share previous experiences and explore facilitation practices collaboratively may be more effective than the knowledge transmission method.[29,30]

Like many other medical and dental institutions, new entrants to the undergraduate programme did not have any prior experience of PBL, which impacted on their experiences adversely, at least initially. These findings highlight the need for a structured induction to PBL and the faculty at our institution is working actively to address the gaps in student induction to facilitate the transition of new entrants. Furthermore, the participants' workload related to the medical content and frequency of PBL sessions affected their motivation and time management. This issue had also been flagged up by students in their end-of-semester feedback in the previous academic year. Given the medical content in PBL cases is mapped to the learning outcomes of the programme and students attend resource sessions jointly with the medical students, this is a more challenging issue. Nevertheless, the PBL content is being actively reviewed by the faculty with a view to reducing medical elements which may not be relevant for dental students. Moreover, PBL cases in the second semester for Year 3 will run over 2 weeks instead of 1 to allow more time for the students to explore diverse learning resources, organise their PBL-related work and self-reflect on their progress.[31]

The findings of this study underscore the need for a research-based approach to evaluate curricula as many assumptions of dental educators can be challenged by new generation of dental students. Moreover, students can provide valuable input into curricular

development and should be treated as partners in curriculum content, design and delivery.[32] This is indeed the case at our institution and development of the curriculum content, and assessments are informed by experiences of the students.

The student focus groups in this research were moderated by full-time faculty staff who were *au fait* with the students' learning journey in PBL settings. The impact of an "insider's" influence in qualitative research remains a topic of intense debate.[33] However, an insider researcher can offer several advantages to the quality of the study including familiarity with the research topic and better understanding of participants to produce richer data.[34] It was ensured that PBL facilitators did not moderate focus groups for students in their PBL groups. This step was aimed at encouraging the participants to express their opinions and experiences freely which might have been more challenging in the presence of their PBL facilitator.

The main limitation of this research is that participants were from a single institution, and it may not be possible to generalise the findings. Nevertheless, this study provides sufficient details of the methodology, data collection and analysis to facilitate transferability.[35] Further research involving institutions with a different sociocultural profile may enhance the existing understanding regarding the interplay between PBL and self-regulation in undergraduate dental education.

5 | CONCLUSION

This study provides useful insights into the learning experiences of students at a newly established dental institution with a PBL curriculum. PBL was perceived to be an appropriate and effective strategy to support student autonomy in construction of knowledge and developing problem-solving and interpersonal skills to enhance student motivation and self-efficacy. However, participants considered workload of PBL sessions to be heavy and impacted adversely on their time management. Structured induction of new students into PBL and further training of PBL facilitators were also recommended by the participants to improve the learning experiences of the students. The findings of this study highlight the benefits and challenges of PBL to optimise self-regulation in undergraduate dental education.

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CONFLICT OF INTEREST

None of the authors / co-authors have any conflict of interest to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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