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Does problem-based learning facilitate enactment of learner agency in undergraduate dental curricula? A Q study

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Abstract

Introduction: Addressing a literature gap on leaner agency in health profession education, this study explores students' perceptions on which aspects of a problem-based learning (PBL) environment cradle their leaner agency enactment.

Methods: Thirty-eight students from a newly established undergraduate dental medicine programme in Qatar participated in the study. Q methodology was adopted to collect and analyse data both qualitatively and quantitatively. A 40-statement Q-set was established based on a proposed conceptual framework of learner agency in PBL, including three dimensions—intrapersonal, behavioural and environmental.

Results: Q methodological factor analysis identified four significantly different student viewpoints, which underscored participants' enactment of learner agency addressing the intrapersonal, behavioural and environmental dimensions of the conceptual framework. Despite differences in opinion regarding sources of learner agency, the four student viewpoints unanimously underscore the importance of PBL facilitators' expertise to nurture and develop agency amongst undergraduate students. Post-sorting qualitative data further confirmed the quantitative analysis. Time constraints and workload were identified as the main challenges by the participants.

Conclusions: This study explored enactment of learner agency as perceived by undergraduate dental students in a PBL curriculum. The findings of this study provide new insights into participants' subjective understanding of learner agency in a PBL curriculum in dentistry. Structured support is needed for students having no prior PBL experiences to develop their learner agency at both intrapersonal and behavioural (self-regulated learning) dimensions, and to ensure they interact with their learning environment proactively.

KEYWORDS
early year dental curriculum, learner agency, problem-based learning, Q methodology

1 | INTRODUCTION

Agency is one of the most vital human traits and may be described as an individual's desire and capacity to act. Given its focus on decision-making, problem-solving, creativity, collaboration, self-regulation and capabilities of dealing with uncertainty, learner agency is gaining an increasing attention in professional programmes in higher education.[1,2] Developments in socio-constructivist understandings of learners underscore the agentic interaction between learners and their environments and learning contexts. Learner agency is a complex phenomenon that includes three interrelated aspects: (1) learners' sense of agency through their subjective perceptions of how agentic they are in a given context[3-5]; (2) learners' agentic behaviour indicated through the choices they make and how they enact agency[4-6]; and (3) how learners interact with their environment (i.e. teamwork), purposefully or unconsciously, actively or passively.[3,6,7]

Learning environment plays a key role in supporting the development of student agency.[2] In particular, problem-based learning (PBL), which has been well-used in healthcare education, has the characteristics and advantages of supporting students to become proactive learners. Literature in medical and health education has suggested that PBL may support development of clinical reasoning, team-working and deep learning,[8] and enhance students' satisfaction, motivation, attitudes and outcomes regarding cognitive development in medical curricula.[9] Research in dental education has also reported that PBL enhances active student participation, and improves clinical reasoning and diagnostic skills of students.[10,11] PBL also has a positive impact on graduation rates, and entry into postgraduate programmes whilst reducing attrition rates.[12] Learner agency is a key objective of a PBL approach, from problem identification, solution finding and teamwork to work collaboratively on clinical problems. There is merit in supporting dental students' agency development to improve motivation, self-directed learning, professionalism and development of their professional identity to boost their preparedness.

Nevertheless, there is limited research on how students become proactive learners and agentic professionals at an earlier stage of the curricula.[13,14]

The study setting was the College of Dental Medicine, Qatar University which accepted its first cohort of undergraduate dental students in 2019. A first in the state of Qatar, the dental programme entails 6 years of full-time study and is based on an evidence-based, student-led curriculum. The dental students construct their knowledge in problem-based learning sessions and are supported by lectures and small-group resource sessions provided by the dental and medical faculty.

The PBL sessions (two three-hour sessions per week) are aimed at encouraging students to integrate biomedical knowledge with behavioural, social, ethical and biopsychosocial approaches to patient care. During the first session of the PBL case, students are given a clinical case organised as a series of triggers depicting the patient journey from the time of initial presentation, followed by clinical assessment, investigations, management and follow-up. The students work as a group to identify the learning objectives of the case. The students distribute the workload related to the case and reconvene at the end of the week to deliberate on various aspects of the case using student-led presentations, concept maps and critical appraisal of a published research article related to the clinical scenario. PBL in Year 2 is focused on medical problems whilst in Year 3, the PBL cases have a combination of medical and dental problems.

Recent research in other disciplinary settings in Qatar University prior to pandemic showed that when PBL was initially implemented, students, appeared to be less agentic in becoming self-regulated learners as expected by educators. This may be due to teacher-centred educational systems in Qatar.[15,16] Lack of skills in self-directed learning in PBL emerged as a challenge when the teaching and learning activities had to be moved online during active stages of the COVID−19 pandemic.[15] The current study explores how students at a newly established dental programme perceive their agency during early stages of a PBL curriculum, in a post-pandemic context.
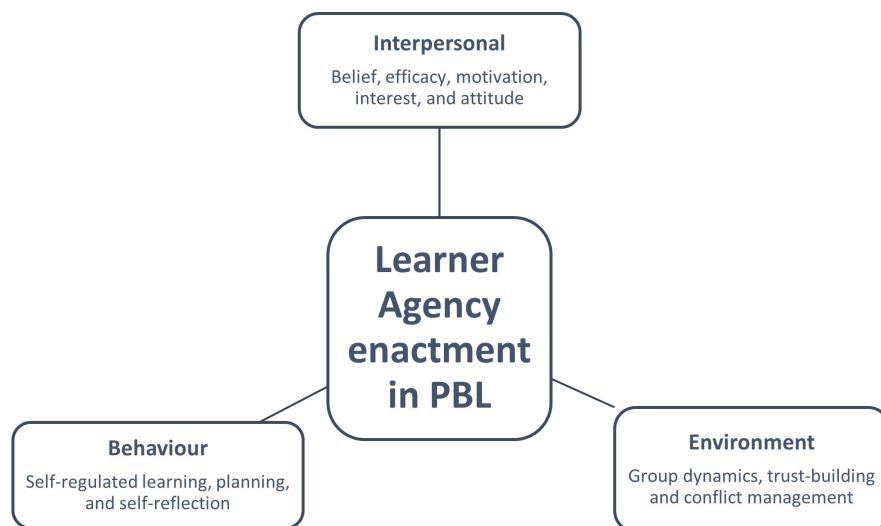

FIGURE 1 A model of learner agency in problem-based learning consisting of three interrelated dimensions

1.1 | Conceptual framework

The conceptual framework of this study is informed by a subject-centred sociocultural approach to underscore an interplay between an individual's experiences and the social context in which they exercise agency.[7] The framework, as illustrated in Figure 1, is derived from a recent study on learner agency development in engineering education[17] which was embedded in Bandura's (2006) works on three interrelated dimensions of agency, that is, intrapersonal values, behavioural aspects and interaction with the environment.[1]

The intrapersonal values highlight students' belief and efficacy towards learner-centredness,[4,5] and their attitudes in a PBL environment.[18] Their personal characteristics influence their learning experiences.[2]

The behavioural dimension emphasises self-regulated learning and requires the students to set up their own learning goals, make plans, search for information on their own and monitor their learning process, as well as reflect and self-evaluate.[18-20] Teamworking skills facilitate student collaboration to explore multiple sources of information for problem-solving, share information, provide peer feedback, develop team dynamics and handle potential conflicts.[21]

The environmental dimension underscores the interaction between individual dental students and their surroundings, including learning materials, institutional resources, policies including assessment methods, and other aspects related to society and culture.[2,22] Learners may become proactive in a supportive and open-minded environment, whereas they may become passive in a threatening or rigid institutional culture[22].

2 | METHODS

2.1 | Methodology

Q methodology[23,24] was used to collect and analyse data both qualitatively and quantitatively. Considered as a useful method to explore subjective opinions of individuals, it relates individuals to each other to explore shared and contrasting thoughts within the participant group, and explores the complexity of belief systems.[25] Q methodology is gaining popularity in medical education.[26] The study was guided by the six-step procedure as synergised by a systematic review of Q methodology in educational research.[27] These steps included (i) Concourse development, (ii) Q- set construction, (iii) Q sorting, (iv) post-sorting, (v) Q factor analysis and (iv) factor interpretations.

The concourse (including 98 statements initially) was developed from review of educational literature on PBL in medical education and informed by the conceptual framework (Figure 1). The framework of learner agency in PBL was used to structure and condense statements (Table 1), which was followed by three rounds of expert review and piloting. A 40-statement Q-set was agreed by the research team after expert validation and pilot feedback (Table 1).

2.2 | Setting

College of Dental Medicine, Qatar University.

2.3 | Participants and sampling

Following ethics approval by the institutional review board, purposive sampling was used to invite current students experiencing PBL sessions in year 2 and 3 at the College of Dental Medicine.

2.4 | Data collection

Targeted participants were invited to conduct the Q sorting, using an online version of QMethod Software. A web-link was sent to all participants through their university email. Participants were asked to rank 40 items, according to their perceived importance in supporting participants' agency development and effective implementation of PBL. The participants used an online "drag and drop" sorting tool to assign each item a hierarchical position in the symmetrical distribution grid from "least important" (–5) to "most important"

TABLE 1 From concourse development to Q set

Dimension of professional agency as a PBL facilitator[a]	Statement number	N = 40
Intrapersonal dimension: individual belief, efficacy, motivation, interest, attitude, intention	1, 2, 11, 12, 20, 27, 30	7
Behavioural dimension: self-directed learning including goal setting, plan making, monitoring, adopting strategies and learning sources, self-reflection, and evaluation, individually and as a team, in the PBL process	3, 4, 9, 10, 13, 14, 16, 17, 18, 22, 23, 26, 29, 31, 32, 35	16
Environmental dimension: team atmosphere and dynamics, interdependence, relations, leadership, trust building, conflict management, time management, etc.	5, 6, 7, 8, 15, 19, 21, 24, 25, 28, 33, 34, 36, 37, 38, 39, 40	17

aBandura (2006),[1] Du et al. (2020).[29]

(+5) (Figure 2). Through this highly engaging activity, each participant generated a single, holistic configuration of their viewpoints. Additional open-ended questions in the *post-sorting activity* were used to collect qualitative data to gain an understanding of participants' ranking decisions.

2.5 | Data analysis

Following collection in the QMethod Software, raw data were imported into KADE to identify correlations and inverted factor analysis was carried out. Eigenvalues of 1.00 or above, with two or more significantly loading participants per factor, were used for decision making.[23] A holistic approach to factor interpretation was employed across the range of factor arrays (a weighted average of values per item within one factor).[23] No significant factor inter-correlations were identified, confirming the choice of the four-factor solution, including 29 of 38 participants significantly loaded on one of the four factors. Nine Q sorts were excluded as they did not load significantly or were confounded. Table 2 provides an overview of the values ascribed to statements each factor, listing those with the highest Z-score variance, suggesting the most disagreement, to those with the highest Z-score variance, suggesting the highest agreement.

3 | RESULTS

The following sections describe the factors which emerged from the Q analysis. As factors represent participants' own perceptions of learner agency sources, the term *viewpoint* is used to highlight their subjective character.[28] Each viewpoint is presented followed by a narrative summary including quantitative attributes and factor interpretation. Each statement is referred to by its item number and rating on a scale from −5 to +5; for example, "#19/5" refers to statement 19 with the value of 5. To highlight statements on which the viewpoints were significantly different, "D" is added after the value number to represent "distinguishing statements" ($p < 0.05$) or D* to represent "significantly distinguishing statements" ($p < .01$). Post-sorting information was used to confirm, explain or further elaborate the overall narratives.

Table 3 provides an overview of results summarised by participants' demographic data and prior PBL experience, along with the highest and lowest-ranked statements across all three dimensions of learner agency.

Results of each viewpoint are reported in the following sections and related to the conceptual framework of learner agency in PBL.

3.1 | Viewpoint 1: focus on individual efforts towards career readiness

Viewpoint 1 ($n = 9$) highlighted the importance of individual roles in PBL across all three dimensions. On the environmental dimension, they valued dividing tasks amongst the members (#34/5), having a group leader (#15/4) and participating in decision-making (#8/4D). Individual efforts were perceived to be important to build team trust (#36/3D). Behaviourally, they emphasised individual efforts to improve grades in PBL (#26/5) and the importance of identifying learning objectives (#3/3D*). Participants also ranked distinguishingly high on two intrapersonal statements related to PBL skills (#20/4D*) and PBL knowledge (#11/2D*).

Participants' post-survey responses reiterated their views regarding individual roles, highlighting the need for each group member to complete tasks assigned to them during PBL sessions. Individual performance can "*impact on grades which are important to progress on the course.*" Improving career readiness was considered distinguishingly important by these students (#28/2D*).
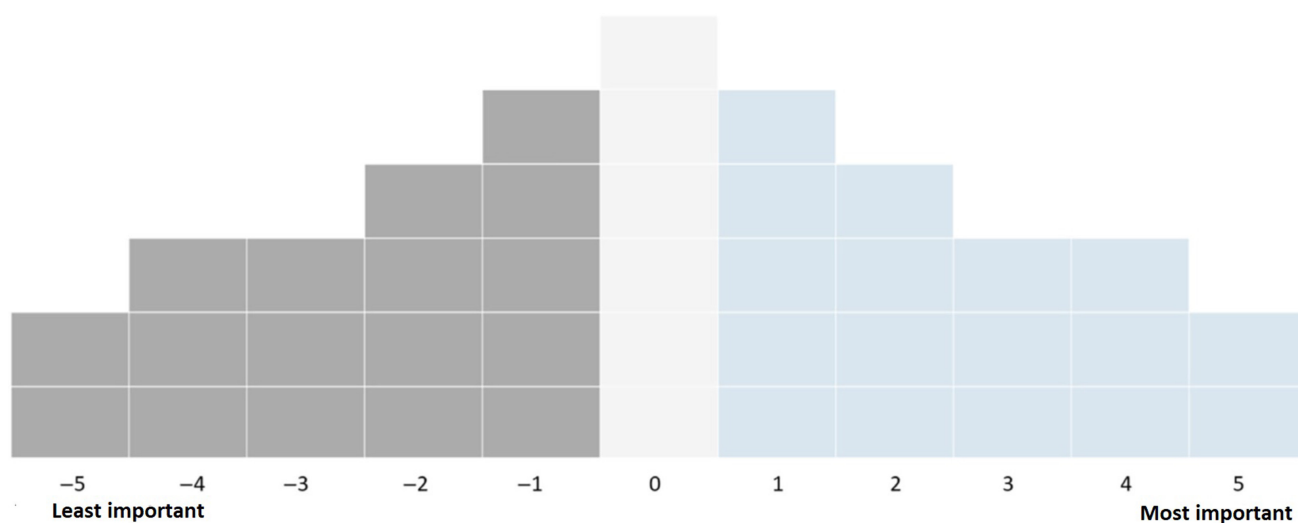

FIGURE 2 Q-sort distribution grid. Participants individually assigned each of the 40 statements a slot in this grid from least important to most important

TABLE 2 Factor Q values for statements sorted by level of consensus (from consensus to disagreement)

Statement	D	F1	F2	F3	F4	Z-score variance
17: My group consults additional sources of expertise other than our PBL facilitators.	B	–1	–3	–3	-2	0.024
39: My group members challenge each other to learn more.	E	–4	–1	–1	–4	0.115
13: My group uses some members' prior PBL experiences in subsequent cases.	B	–5	–2	–2	–4	0.118
14: My group modifies our PBL process based on our learning needs.	B	0	–1	–4	–2	0.119
23: My group searches for diverse sources of knowledge to work on the case.	B	0	2	1	3	0.135
18: My group consults additional sources of expertise other than our PBL facilitators.	B	–2	–2	–1	–5	0.145
38: My group helps under-performing members.	E	1	0	–1	1	0.15
9: My PBL experience helps me develop clinical reasoning skills.	B	0	0	–3	–1	0.165
6: My group tries to handle challenges on our own before we consult our PBL facilitators.	E	–1	0	2	1	0.18
10: I use my prior PBL experiences in the current case.	B	0	–2	1	–2	0.188
2: I enjoy trying new ways to learn.	I	–1	–5	0	–2	0.212
34: My group divides tasks amongst the members.	E	5	5	4	3	0.225
20: I have the skills to work in PBL.	I	4	1	0	0	0.245
26: I make efforts to improve my grades in PBL assessments.	E	5	4	5	3	0.247
15: My group has a leader to coordinate our case work.	E	4	3	2	0	0.308
5: My group makes efforts to manage time efficiently.	E	–3	–3	0	1	0.348
25: I prioritise the tasks assigned to me by the group.	E	1	2	–2	2	0.356
7: I take initiatives in the PBL process.	E	2	–3	0	–1	0.358
30: The facilitator is no longer the major source of authorised knowledge in PBL sessions.	I	–3	0	1	1	0.368
31: My group relies on resource sessions provided by the teaching faculty.	B	2	5	5	2	0.382
40: My group members compromise to reach consensus regarding workload.	E	0	4	0	–1	0.404
8: I participate in the decision-making during the PBL case discussions.	E	4	2	2	–1	0.443
36: My group members make efforts to build mutual trust.	E	3	1	–1	2	0.446
11: I am knowledgeable about how PBL sessions work.	I	2	0	–3	0	0.509
37: My group copes with conflicts. amongst our group members constructively.	E	–2	3	0	4	0.526
24: I feel comfortable to express my opinions in my group.	E	3	0	1	5	0.569
3: My group works together to identify the learning objectives of each PBL case.	B	3	1	1	–3	0.593
32: My group regularly interacts with other groups to learn from their progress.	B	–5	–5	–1	0	0.6
33: My group communicates regularly on our case work.	E	1	3	4	–1	0.632
28: I engage with my PBL group to improve my career readiness.	E	2	–4	–4	0	0.659
4: I use feedback from the facilitator to guide my learning.	B	1	–2	4	0	0.675
16: My group regularly follows up on our learning plans.	B	–1	–1	3	–4	0.702
21: My group ensures all of us have reached the expected learning outcomes for each PBL case.	B	–2	1	–4	1	0.706

(Continues)

TABLE 2 (Continued)

Statement	D	F1	F2	F3	F4	Z-score variance
19: I provide constructive feedback to other members of my group.	B	−1	−4	2	2	0.761
35: My group seeks assistance from the course/year leads if required.	B	1	−4	−2	−5	0.819
29: I use the assessment rubric to guide my learning	B	−2	−1	3	−3	0.882
1: PBL is appropriate for maximising my learning.	I	−4	4	−2	−3	1.038
22: My group regularly reflects on our progress.	B	−4	−1	3	4	1.084
27: I have developed a sense of becoming a professional dentist in PBL.	I	0	2	−5	5	1.429
12: The PBL sessions have enhanced my motivation to learn dentistry.	I	−3	1	−5	4	1.954

Note: B, behavioural dimension; D, dimensions; E, environmental dimension; F, factor; I, intrapersonal dimension.

TABLE 3 Summary of viewpoints

V	N	Expl. variance	Year: n (team constellation)	Age range	Prior PBL experience	Highest ranked #	Lowest ranked #
V1	9 (5F + 4 M)	12%	2: 5 (cross 2 teams) 3: 4 (cross 2 teams)	19–21	Yes: 4 No: 5	26 (B) 34 (E)	13 (B) 32 (B)
V2	9 (9F)	9%	2: 6 (cross 3 teams) 3: 3 (cross 2 teams)	19–20	Yes: 3 No: 6	31 (B) 34 (E)	2 (I) 32 (B)
V3	3 (2F + 1 M)	7%	2: 3 (cross 3 teams) 3: 0	18–21	Yes: 0 No: 3	26 (B) 31 (B)	27 D* (I) 12 D* (I)
V4	8 (6F + 2 M)	9%	2: 6 (cross 3 teams) 3: 2 (cross 2 teams)	18–21	Yes: 2 No: 6	24D* (E) 27D* (I)	18 (B) 35D* (B)

Note: #, number of statement; B, behavioural dimension; D, distinguishing statement at $p < .05$; D*, distinguishing statement at $p < .01$; E, environmental dimension; Expl variance, explained variance; F, female; I, intrapersonal dimension; M, male; N, number of sig. loading sorts; V, viewpoint.

"*My main aim is to become a competent, and knowledgeable health-care provider who is able to provide high quality care to patients. Anything that will enhance my professional development is of critical importance.*"

The participants placed greater emphasis on their individual role compared to group values. They did not consider PBL as an appropriate method to maximise learning (#1/-4) and did consider the facilitators' role as a major source of authority (#30/-3D*). Other statements which were considered unimportant included using group members' prior PBL experiences (#31/-5), interacting with other PBL groups (#32/-5) and group reflection (#22/-4D*). In their group environment, they did not value challenging each other in the group (#39/-4), time management (#5/-3), coping with conflict (#37/-2D*) and learning from other PBL groups in their cohort (#6/-1D*).

These rankings were related to participants' own conceptions about learning in PBL settings, which limited their available resources, as stated in their post-survey responses. As explained by one student, "*Interacting with another PBL group will lead to comparisons and you may start getting unsatisfied about your own group … so, this can lead to confusion.*" Despite their low ranking of time management, most of the participants explained that efficient time management remained a challenge in PBL sessions. Due to the time

constraints, they chose to rely on learning resources provided by facilitators, instead of searching for additional information themselves.

In summary, participants sharing Viewpoint 1 focused individual effort and performance rather than group work. Although having limited appreciation of the benefits of PBL at this stage, they valued opportunities which may contribute towards preparedness as a dentist. Focus on individual performance and reliance on learning resources provided by the faculty limited their self-regulation in learning.

3.2 | Viewpoint 2: belief in PBL as an appropriate learning method

Viewpoint 2 (*n* = 9 female) also addressed importance of all three dimensions. Contrasting with Viewpoint 1, participants in this group believed that PBL is appropriate to maximise learning (#1/4D*). As one student wrote, "*we work as a group to perform what is required which has improved our teamworking skills and this will also help us on the clinic in the future.*" These students considered dividing tasks amongst the members (#34/5) (similar to Viewpoint 1) and compromising to reach consensus regarding

workload (#40/4D*) (distinguishing from other Viewpoints), prioritising tasks assigned by the group (#25/2) and achieving the learning objectives (#21/1), as highly important. As confirmed by the post-sorting responses, these students considered it essential to satisfy all group members with the distribution of workload for the PBL cases. This group also valued resource sessions provided by the teaching faculty (#31/5). As explained by one student "*Faculty members make it easier for us to identify information which is relevant to our stage of the course rather than feeling lost whilst searching endlessly.*"

On the negative side, Viewpoint 2 participants reported lowest on trying new ways to learn (#2/-5D*). Two students did not see much relevance of solving medical cases in PBL and they preferred learning problems related directly to dentistry.

Participants in this group did not consider interacting with other PBL groups to be important (#32/-5) (same as Viewpoint 1), consulting additional sources of expertise (#17/-3D*), or using facilitators' feedback (#4/-2D*). On the environmental dimension, these students did not consider PBL to be important in improving their career readiness (#28/-4) (contrasting Viewpoint 1), constructive feedback (#19/-4D) and taking initiatives (#7/-3D*), time management (#5/-3) (similar to Viewpoint 1). As they explained in the post-survey, these choices did not mean the aspects were not important but rather the students did not prioritise them due to the heavy workload related to PBL sessions.

Viewpoint 2 participants, unlike Viewpoint 1, placed high intrapersonal value on efficacy in PBL and beliefs about PBL appropriateness, as well as group consensus. Nevertheless, behaviourally, similar to Viewpoint 1, they relied on learning resources provided by the faculty instead of seeking additional sources of expertise. Therefore, they exhibited less self-regulated learning primarily due to the heavy workload, limited preparation time for PBL sessions and lack of direct relevance PBL cases to dentistry.

3.3 | Viewpoint 3: reliance on learning resources provided by the faculty

Viewpoint 3 participants ($n = 3$) were year two students who had no prior experience in PBL. For this group, the most important elements for learner agency were behavioural aspects, including reliance on resource sessions provided by the teaching faculty (#31/5), individual efforts to improve grades in PBL (#26/5) (similar to Viewpoint 1), using facilitators' feedback (#4/4D*), using the assessment rubric to guide learning (#29/3D*) and following learning plans (#16/3D*). As students explained in their post-sorting responses, following what was provided and expected by the faculty was a safe way to ensure progression on the course. Additionally, three environmental statements were highly ranked including group communication (#33/4), dealing with challenges (#6/2) and constructive feedback (#19/2) (unlike Viewpoint 2). These priorities were further confirmed by their post-sorting responses. As explained by one participant "*Feedback is very important as it helps improve my academic performance & grades.*"

On the negative side, these participants ranked intrapersonal dimension statements on enhancing motivation to learn dentistry (#12/−5*) and developing a sense of becoming a professional dentist (#27/-5*) as the least important aspects, in contrast to other Viewpoints. Other statements which were ranked low included three behavioural dimension statements, that is, consulting additional sources of expertise (#17/-3D*) (same as Viewpoint 2), modifying PBL process (#14/−4), developing clinical reasoning skills (#9/-3D). Some statements related to the environmental dimension were also ranked low including: achieving expected learning outcomes (#21/-4) (contrasting with Viewpoint 2), improving career readiness (#28/−4) (similar to Viewpoint 2 and contrasting with Viewpoint 1), prioritising the tasks assigned by the group (#25/-2D*) (unlike Viewpoint 2) and building team trust (#36/-1D*) (unlike Viewpoint 1).

These choices were possibly related to the fact that participants were from year 2 and had limited experience of PBL. One student commented that "*It was hard to express our opinions because we always thought that we must choose the correct answer to avoid judgements, this fear often makes us reluctant to participate.*" In addition, the PBL cases for year 2 were mainly related to medicine with little direct relevance to dentistry, which might have made it difficult for the students to contextualise it to their future role as a dentist.

In summary, Viewpoint 3 participants had limited understanding of PBL and could not fully appreciate the long-term benefits of PBL. For this group, it is important to follow the resources provided by the faculty. Such a focus restricted them to appreciate the value of PBL in developing clinical reasoning skills and developing a sense of professional identity as a dentist.

3.4 | Viewpoint 4: development of a professional identity

Viewpoint 4 ($n = 8$) reported positively on statements across all three dimensions. Within the intrapersonal dimension, compared to other viewpoints and particularly contrasting Viewpoint 3, these participants stressed the importance of PBL in developing professional identity as a dentist (#27/5D*) and enhancing motivation to learn dentistry (#12/4D*). Post-sorting responses confirmed students' agreement that it is important to motivate students and maximise learning through development of a professional identity. A year-3 student wrote, "*I prefer clinical scenarios given to us this semester, as the cases are dentally oriented. It gives me a sense of being a dentist, as I can now evaluate cases and see how medical problems impact on clinical dental care.*"

Additionally, belief change regarding the facilitator no longer being the major source of authority in PBL sessions (#30/1) was also emphasised. A student wrote that the facilitator was not the main source of information "*because one of the main goals of PBL is for us to be independent and have the ability to explore different sources of information.*"

Within the environmental dimension, they reported the importance of expressing opinions in group (#24/5D*), coping with conflicts (#37/4D), constructive feedback (#19/2), prioritising the tasks assigned by the group (#25/2), time management (#5/1) and helping under-performing members (#38/1). Additionally, two behavioural statements were highlighted including group reflection (#22/4) and searching for diverse sources of knowledge to work on the case (#23/3). In the post-sorting survey, one student mentioned "*I think constructive feedback and reflection are the two most important aspects when trying to learn new skills.*"

Viewpoint 4 ranked lowest on behavioural statements, including seeking assistance from the year leads (#35/-5D*), consulting additional sources of expertise (#18/-5D), following up plans (#16/-4D*), using assessment rubric to guide learning (#29/-3D*), working together to identify the learning objectives (#3/-3D*) and using prior PBL experiences (#10/-2). Also ranked low were four environmental statements: challenging each other to learn more (#39/-4), group communication (#33/-1D*), participating in decision making (#8/-1D*), compromise to reach consensus regarding workload (#40/-1). In their post-sorting responses, they regarded guidance from PBL facilitators to be adequate and consulting other sources were not considered to be necessary.

In summary, Viewpoint 4 demonstrated a deeper understanding and a better appreciation of the benefits of PBL. Contrasting with Viewpoint 3, participants considered PBL to be important to help them develop their professional identity. The importance of team-working and performance were also emphasised. Whilst they significantly prioritised some features of team performance, such as group members challenging each other, these participants also undervalued other team-related aspects, such as providing team members with constructive feedback. Regarding learning resources, participants valued multiple sources of information to solve the case. However, they did not place much importance on seeking help from other experts apart from their PBL facilitators, indicating a limited self-regulated learning at this stage.

3.5 | Consensus statement

Despite the diverse perceptions observed across the four Viewpoints, statement 17 on "my group consults additional sources of expertise other than our PBL facilitators" indicated a significant consensus. Similarly, statement 23 and 18, although not agreed unanimously, reflected on common ideas regarding limited effort to explore diverse learning sources, and instead, relying on learning resources provided by the faculty. These findings indicate the need to further improve self-regulated learning skills in PBL.

Time management, although not highlighted in viewpoints' choices, was frequently reflected as a challenge by more than 80% of participants. Difficulties in balancing workload related to PBL sessions, along with other academic commitments was emphasised by participants across the board.

Significant disagreement was observed on statements 12, 27 and 2 which highlights variations in the intrapersonal beliefs of participants regarding the value of PBL in addressing their learning needs and facilitating their journey to become a dentist.

4 | DISCUSSION

Q methodological factor analysis identified four significantly different student viewpoints: (1) focus on individual efforts towards career readiness, (2) belief in PBL as an appropriate learning method, (3) reliance on learning resources provided by the faculty and (4) development of professional identity as a dentist. All three dimensions of the proposed conceptual framework on learner agency in PBL, that is, intrapersonal, behavioural and environmental dimensions were addressed by most viewpoints. This indicates that enactment of an individual learner's agency is a complex phenomenon which is shaped by an interplay between personal traits and capacities; interactions with others, resources and sociocultural conditions[3,6,7] Whilst Viewpoint 4 demonstrated a higher level of learner agency emphasising professional identity development in PBL, Viewpoints 1 and 2 lack of confidence in the PBL process due multiple reasons. Viewpoint 3 appeared to be less agentic as participants chose to focus on progression requirements of the course. This result echoed findings from the previous research[15] which suggested that when students are exposed to PBL as a learning method without nurturing professional identity, their enactment of agency is also compromised.

Despite the variations in student perceptions, the four student viewpoints unanimously underscore the importance of replying resources provided by the faculty and seeing PBL facilitators as the major source of correct information. Such agreement revealed the limitation in their self-regulated learning at this stage of the programme. Interestingly, lack of self-regulation in PBL has been previously reported in studies pre and post COVID-19 pandemic.[21] Therefore, this limitation is not related to the pandemic per se and may be attributed to the historical and cultural factors in education whereby teachers are seen as the major source of knowledge.[29] Although this may take a long time to achieve, students' must be encouraged to become independent learners in order to fully benefit from PBL.[16]

Nevertheless, this study shows that overall, the students were positive about PBL as an appropriate method to learn application of knowledge.[11,14,30] Students also expressed positive views regarding their initial PBL experiences. In their post-sorting responses, they reported various perceived learning gains including active learning, improved communication skills and teamworking. As one student wrote, "*In PBL we can learn new information from each other as colleagues which enhances our motivation for learning more than when we hear it from lecturers.*"

Although demographic factors did not appear to have a significant impact, students who were new to PBL reported more uncertainty and focused on survival on the course. The post-sorting analysis confirmed better understanding of PBL by year 3 students. Experience in PBL contributed to better appreciation of the benefits

of PBL as well developing a professional identity. In contrast, one third of the participants (a few from year 3 and mostly from year 2) failed to see opportunities of using PBL to develop collaborative learning skills, clinical reasoning skills and career readiness. These differences indicated a need to provide further support to the students to construct knowledge and develop relevant skills.[15]

Use of medical cases in PBL sessions without contextualising it to dentistry may impact adversely on the motivation of dental students. Adding a dental flavour to medical cases in likely to enhance the interest of dental students and contribute to development of their professional identity.[21] Moreover, moderating the PBL frequency and workload would encourage self-reflection and improve self-regulated learning.

Based on the findings of this study and course evaluations by the students, several changes have been implemented in PBL sessions at our institution. First, the PBL cases in Year-2 have been reviewed to include a combination of medical and dental problems. The aim is to help students appreciate how medical problems impact on dental care of patients from an early stage. Another major focus is to improve the quality and frequency of feedback to the students.[31] Additional training sessions on providing feedback have been put in place for the PBL facilitators. Moreover, the facilitators now provide one-to-one feedback sessions after each PBL case and encourage students to reflect on their performance in each PBL session. The student workload for PBL sessions has also been reviewed and the students have been provided protected time for self-directed learning in their weekly academic timetable. Initial feedback by the students indicates that these changes have been received positively.

A few limitations of this study warrant acknowledgement. First, the current study is limited to dental students' agency at an early stage of the curriculum. Longitudinal follow-up studies may help to explore how students' learning experiences and perceptions change, particularly with a transition into clinical courses involving direct patient care. Second, only 29 of the 38 participants were included in the four significantly different Viewpoints due to the choice of a 4-factor solution in Q analysis. Opinions of the remaining nine participants could not be represented. It is acknowledged that use of classic qualitative methods would have provided additional perspectives to enhance our understanding of PBL. Finally, participants in this study were from a single institution, which limited the external applicability of the study. Future studies involving a larger sample from multiple institutions may improve our understanding regarding learner agency in undergraduate dental education.

5 | CONCLUSION

This study explored enactment of learner agency as perceived by undergraduate dental students in a PBL curriculum at a newly established institution. Q methodological factor analysis identified four viewpoints by the participants related to their beliefs about learning and understanding of PBL. These findings provide new theoretical insights into participants' subjective understanding of learner agency in a PBL curriculum in dentistry. Whilst the importance of self-regulated learning was highlighted in PBL, it was addressed both actively and passively by participants in this study. Structured support is needed for students having no prior PBL experiences to develop their learner agency at both intrapersonal and behavioural (self-regulated learning) dimensions, and to ensure they interact with their learning environment proactively. The study may be relevant to healthcare educators who wish to implement PBL in undergraduate programmes.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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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