



ORIGINAL ARTICLE

Undergraduate dental students' perceptions of team-teaching: A Malaysian experience on cross-professional preclinical education

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Received 14 April 2023; accepted 20 October 2023



KEYWORDS

Cross-discipline learning;
Health profession;
Pedagogy;
Preclinical;
Undergraduate

Abstract

Introduction: Limited research has been conducted to determine how undergraduate dental students perceive team-teaching, especially when involving teachers from other allied dental professions. Therefore, the current study aimed to determine students' perceptions of team-teaching in a preclinical dental materials science course.

Methods: The current laboratory dental materials practical session was carried out for the second-year undergraduate dental students. The session was conducted solely by a dental technology lecturer in the dental technology laboratory. Students attended lectures on commonly used laboratory-based dental materials before the session comprising seven teaching and learning stations. 19 close-ended questions using 5-point Likert Scales to assess 4 domains (perception of learning, teacher, learning environment, and preference of learning) including 2 open-ended questions were administered at the end of the session. Mean scores for each questionnaire item were analysed, whereas content analysis was performed for open-ended responses.

Result: The respondent rate was 100% ($n = 68$). Mean scores for domains 1, 2, 3, and 4 ranged from 4.35–4.69, 4.63–4.87, 4.53–4.69, and 2.93–3.74, respectively. Cronbach's alpha value for all the questionnaire items was 0.85, while confirmatory factor analysis scores for all domains were >0.7 , with 2 items being removed. Based on the open-ended responses, students enjoyed the communication between the teacher and students and wished to have more hands-on activity.

Conclusion: Students generally showed positive perceptions towards their learning, teacher, and learning environment, despite showing mixed preference towards team-teaching.

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PALABRAS CLAVE

aprendizaje cruza-disciplinario;
profesión de la salud;
pedagogía;
preclínica;
pregrado

Additional research is required to evaluate teachers' and policymakers' perspectives as well as the impact of team-teaching on students' academic performance.

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Percepciones de los estudiantes de odontología de pregrado sobre la enseñanza en equipo: una experiencia de Malasia en educación preclínica cross-profesional

Resumen

Introducción: Se han realizado una investigación limitada para determinar cómo perciben los estudiantes de odontología de pregrado la enseñanza en equipo, especialmente cuando involucra a docentes de otras profesiones dentales afines. Por lo tanto, el presente estudio tuvo como objetivo determinar las percepciones de los estudiantes sobre la enseñanza en equipo en un curso de ciencia de materiales dentales preclínicos.

Métodos: La sesión práctica actual de materiales dentales de laboratorio se llevó a cabo para los estudiantes de odontología de segundo año. La sesión fue conducida únicamente por un docente de tecnología dental en el laboratorio de tecnología dental. Los estudiantes asistieron a conferencias sobre materiales dentales de laboratorio comúnmente utilizados antes de la sesión, que comprendía siete estaciones de enseñanza y aprendizaje. Se administraron 19 preguntas cerradas utilizando escalas Likert de cinco puntos para evaluar cuatro dominios (percepción del aprendizaje, del docente, del entorno de aprendizaje y preferencia de aprendizaje), incluyendo 2 preguntas abiertas al final de la sesión. Se analizaron las puntuaciones medias de cada ítem del cuestionario, mientras que se realizó un análisis de contenido para las respuestas abiertas.

Resultado: La tasa de respuesta fue del 100% (n = 68). Las puntuaciones medias para los dominios 1, 2, 3 y 4 variaron oscilaron entre 4.35 y 4.69, 4.63 y 4.87, 4.53 y 4.69, y 2.93 y 3.74, respectivamente. El valor del Alfa de Cronbach para todos los ítems del cuestionario fue de 0.85, mientras que las puntuaciones del análisis factorial confirmatorio para todos los dominios fueron >0.7, con la eliminación de dos ítems. Basándose en las respuestas abiertas, los estudiantes disfrutaron de la comunicación entre el docente y los estudiantes y desearon tener más actividades prácticas.

Conclusión: Los estudiantes generalmente mostraron percepciones positivas hacia su aprendizaje, maestro y entorno de aprendizaje, a pesar de tener preferencias mixtas hacia la enseñanza en equipo. Se requiere investigación adicional para evaluar las perspectivas de los docentes y los responsables políticos, así como el impacto de la enseñanza en equipo en el rendimiento académico de los estudiantes.

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Introduction

Dental programme is undeniably a demanding education encompassing numerous clinical and laboratory procedures. In recent years, a paradigm shift from a conventional discipline-based to an integrated competency-based curriculum has occurred.¹ Competency-based education describes the skills, abilities, and moral values that students must have before embarking on autonomous dental practice.² Similarly in Malaysia, the country has transitioned to competency-based dental education for its undergraduate dental curricula. In June 2021, the Malaysian Dental Dean Council organised a workshop and presented a revised national competency statement for Malaysia's prospective dental graduates which was further approved by the Malaysian Dental Council.³ The fundamental goal of the Malaysian dental curriculum is to educate and train clinically competent dental practitioners who will be capable of providing the public with safe and effective oral healthcare services.⁴

Dental materials science is introduced as one of the key courses in the preclinical phase of undergraduate dental programmes in Malaysia, integrating the principles of chemical engineering and materials science with dentistry.⁵

It is essential to note that graduating dental practitioners should be competent at selecting and mixing commonly used clinical- and laboratory-based dental materials in order to provide patients with optimal treatment outcomes.⁶ Furthermore, having a thorough grasp of the materials and procedures used in dental laboratories will ensure effective communications between dental practitioners and dental technologists as well as the construction of high-quality fixed and removable prostheses.^{7,8} However, due to the nature of undergraduate dental curricula with limited exposure in dental laboratory materials and technologies,⁷ it is challenging for a teacher with basic dental degrees to teach laboratory-based dental materials and to keep up with the latest advancements in dental technology, as well as frequently used dental laboratory materials and techniques.

To address this hurdle, it is imperative to share teaching and learning responsibilities through collaboration with other allied dental professionals, notably dental technologists, as they are stakeholders in the delivery of dental care.

Collaborative teaching or co-teaching involves a group of teachers jointly working together in delivering instructions to students and assisting them in their learning.⁹ There are a variety of co-teaching strategies that allow 2 teachers to collaborate in the same classroom, including parallel-, alternative-, station-, and team-teaching. The team-teaching approach includes well-planned, team-taught classes by 2 or more teachers with no established division of power.¹⁰ Every student receives instruction from both teachers who are actively involved in controlling the classes and maintaining the instruction order.¹¹ Moreover, this approach allows both teachers actively participate in managing and organising the classroom and students view both teachers as equals. Both teachers share the lesson and are allowed to provide extra information to aid students in their learning, which encourages task risking in teaching and learning.^{11,12} In addition, some of the problems associated with traditional lecture approach can be resolved by team-teaching such as improves the teacher–student ratio, enhances the quality of instruction, and helps students stay engaged with minimal boredom by using a diversity of teaching styles.⁹

To the best of the authors' knowledge, limited research has been conducted to determine how students perceive team-teaching in dental materials science courses, especially when teachers from other allied dental professions are involved. In the present study, teacher with dental technology background was involved in teaching part of the dental materials science course among undergraduate dental students. Therefore, the aim of this study was to determine the perception of undergraduate dental students on team-teaching in dental materials science course.

Material and methods

Study design and setting

The current study is an educational interventional study. The dental laboratory materials practical session was held at the dental technology laboratory in one of the private dental schools in Malaysia. It was carried out as part of the teaching and learning session for the dental materials science course in the Year 2 Bachelor of Dental Surgery (BDS) program. The dental materials science course has been primarily taught in didactic lecture-based classrooms, with practical sessions on commonly used dental materials in clinical settings (dental cement, dental composite resin, glass ionomer cement, impression materials etc.). Traditionally, these learning activities were delivered solely by teachers with basic BDS degrees and postgraduate qualifications in dental materials science. Therefore, students are never exposed to educational activities on dental laboratory materials taught by teachers with academic backgrounds in dental technology.

Participants and sample size

The participants were second-year undergraduate dental students for the 2022–2023 academic year. A total of 70

students, constituting the entire batch, were invited to voluntarily participate in the dental laboratory material practical session, and 68 of them willingly accepted the invitation. The current study was approved by the local institution ethical committee with ethical approval code of AUHEC/FOD/2023/17. Besides, all participants gave their informed consent before filling out the survey.

Intervention description

Before the dental laboratory materials practical session, students attended lectures on commonly used laboratory-based dental materials including dental waxes, dental ceramics, denture acrylic resins, and dental gypsum products. Students were then divided into 6 groups and assigned to 2 sessions: 3 groups in the morning and the other 3 in the afternoon. Each group consisted of approximately 11–12 students. The 2-h-long practical session comprised 7 stations: orthodontics, metal and alloys, dental implantology, removable prostheses, fixed prostheses, maxillofacial prostheses, and operation machines. The session started with the teacher (who is a dental technologist) giving a short introduction on the learning objectives, followed by teaching and learning activities at each station. The teacher not only showed the available dental laboratory materials, but also explained the materials' properties, applications, and how these materials related to real-world clinical and laboratory scenarios. Subsequently, the teacher demonstrated steep-by-step dental prosthesis fabrication procedures. Students also had the chance to identify the displayed dental prostheses and learn about the variety of machines used to fabricate prostheses, such as duplicating agar machine, vacuum thermoforming machine, centrifugal machine, burn-out furnace, sintering machine, and paco bath machine. Apart from that, students are allowed to observe other dental technologists in fabricating dental prostheses using laboratory-based dental materials. The session concluded with a short debriefing to allow students to recall what they learned throughout the session and ask questions for further clarification. Upon leaving the session, students were requested to complete a structured questionnaire anonymously which was distributed using an online Google Form.

Questionnaire design

The questionnaire used in the present study consisted of 19 close-ended questions using 5-point Likert scales (strongly agree, agree, neutral, disagree, and strongly disagree) and 2 open-ended questions to evaluate students' perception of their learning during dental laboratory materials practical session. The 19 close-ended questions were classified into 4 domains: perception of learning, perception of teacher, perception of learning environment, and preference of learning. The 2 open-ended questions were: (1) What do you think works well in this session? (2) What change would you propose to improve your learning in this session? Content validation of the questionnaire items was performed by 2 faculty members who had prior experience in questionnaire-based research, and it was piloted among 5 undergraduate dental students. Furthermore, Cronbach alpha was

performed to determine the reliability of the closed-ended questionnaire items, while confirmatory factor analysis was used to test the validity among the questionnaire items in their respective domains.¹³

Data collection & analysis

The collected data will be analysed using the IBM Statistical Package for the Social Sciences (SPSS) for Windows, Version 29.0. (Armonk, NY: IBM Corp., USA). Numbers were assigned

to each of the 5-point Likert scales (5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, and 1 = strongly disagree). The mean score and standard deviation for each questionnaire item were calculated. Meanwhile, content analysis was performed for open-ended responses.

Results

All 68 students answered the questionnaire items (100% respondent rate) with the majority of them being females

Table 1 Descriptive results of participants' responses to the questionnaire.

Questions	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)	Mean (SD)
<i>Perception of learning</i>						
1. The session encourages students to learn more on the basic concepts of dental laboratory materials.	48 (70.6)	19 (27.9)	1 (1.5)	0 (0)	0 (0)	4.69 (0.50)
2. The session is more student-centred rather than teacher-centred.	45 (66.2)	17 (25)	6 (8.8)	0 (0)	0 (0)	4.57 (0.65)
3. The session helps students to identify the basic properties, fabrication processes, and applications of commonly used dental laboratory materials.	44 (64.7)	22 (32.4)	2 (2.9)	0 (0)	0 (0)	4.62 (0.55)
4. The session helps students to develop their confidence in selecting the appropriate dental laboratory materials.	40 (58.8)	22 (32.4)	4 (5.9)	2 (2.9)	0 (0)	4.47 (0.74)
5. The teaching time allocated for the session is adequate.	35 (51.5)	25 (36.8)	6 (8.8)	1 (1.5)	1 (1.5)	4.35 (0.82)
6. The learning objectives of the session are well explained.	43 (63.2)	22 (32.4)	3 (4.4)	0 (0)	0 (0)	4.59 (0.58)
<i>Perception of teacher</i>						
7. The teacher is knowledgeable in teaching the basic properties, fabrication processes, and applications of commonly used dental laboratory materials.	54 (79.4)	14 (20.6)	0 (0)	0 (0)	0 (0)	4.79 (0.41)
8. The teacher has good communication skills with the students during the session.	45 (66.2)	21 (30.9)	2 (2.9)	0 (0)	0 (0)	4.63 (0.54)
9. The teacher gives clear examples on the applications of commonly used dental laboratory materials.	50 (73.5)	17 (25)	1 (1.5)	0 (0)	0 (0)	4.72 (0.48)
10. The teacher is well-prepared for the session.	59 (86.8)	9 (13.2)	0 (0)	0 (0)	0 (0)	4.87 (0.34)
<i>Perception of learning environment</i>						
11. The atmosphere in the dental technology laboratory is relaxed during the session.	49 (72.1)	15 (22.1)	4 (5.9)	0 (0)	0 (0)	4.66 (0.59)
12. I feel comfortable being taught by teacher from other allied dental professions during the session.	46 (67.6)	17 (25)	2 (2.9)	2 (2.9)	1 (1.5)	4.54 (0.82)
13. The atmosphere in the dental technology laboratory motivates the students to be active learners.	43 (63.2)	18 (26.5)	7 (10.3)	0 (0)	0 (0)	4.53 (0.68)
14. The environment during the session is comfortable for students to ask questions.	48 (70.6)	19 (27.9)	1 (1.5)	0 (0)	0 (0)	4.69 (0.50)
<i>Preference of learning</i>						
15. I prefer to attend the session that is taught by teacher from other allied dental professions.	8 (11.8)	9 (13.2)	33 (48.5)	12 (17.6)	6 (8.8)	3.01 (1.07)
16. I prefer to participate in dental materials science learning activities (lectures, seminars, practical sessions, etc.) that are taught by 1 teacher (teacher with basic dental degree) only.	7 (10.3)	14 (20.6)	28 (41.2)	15 (22.1)	4 (5.9)	2.93 ^a (1.04)
17. I do not prefer team-teaching to be incorporated into student's academics.	1 (1.5)	3 (4.4)	23 (33.8)	27 (39.7)	14 (20.6)	3.74 ^a (0.89)

^a Scores are reversed in negatively worded questionnaire items.

(72.1%). Among the second-year BDS students, 54 students are Chinese (79.4%), 13 students are Indian (19.1%), and the remaining 1 student is Malay (1.5%). Cronbach's alpha value for all the questionnaire items was 0.85, indicating good internal consistency among the items. On the other hand, the confirmatory factor analysis scores for domains 1, 2, 3, and 4 were 0.78, 0.87, 0.78, and 0.82, respectively. Nevertheless, 2 questionnaire items were found to have a value below 0.5 and were eliminated, leaving 17 closed-ended questionnaire items.

Table 1 shows the mean scores for all 4 domains ranging from 2.93 to 4.87. The first domain (Questionnaire items 1–6) evaluated students' perception of learning towards the dental laboratory materials practical session. More than 88% of the students showed positive learning perceptions towards the session. Item 1 had the highest mean score with 98.5% of the students agreed that the practical session encouraged them to learn more about the basic concepts of dental laboratory materials. This was followed by item 3 with 97.1% of the students agreed that the session helped them to identify the basic properties, fabrication processes, and applications of commonly used dental laboratory materials. Meanwhile, the lowest mean score was noted in item 5 with only 88.3% of students agreed that the teaching time allocated for the session was adequate. The second domain (Questionnaire items 7–10) evaluated students' perception of their teacher. All students (100%) agreed that the teacher was well-prepared for the session and knowledgeable in teaching the basic properties and applications of commonly used dental laboratory materials. 98.5% of the students agreed that the teacher gave clear examples on the applications of commonly used dental laboratory materials and 97.1% of them agreed that the teacher had good communication skills with the students during the session.

Furthermore, the third domain (Questionnaire items 11–14) evaluated students' perception of learning environment. The highest mean score was noted in item 14 with 98.5% of the students agreed that the environment during the session was comfortable for students to ask questions. 94.2% of the students felt that the atmosphere in the dental technology laboratory was relaxed, and 92.6% of them felt comfortable being taught by teacher from other allied dental professions during the session. The fourth domain (Questionnaire items 15–17) evaluated students' preference of learning. 30.9% of the students preferred to participate in dental materials science learning activities (lectures, seminars, practical sessions, etc.) that are taught by 1 teacher only. 25% of them preferred to attend the session that is taught by teacher from other allied dental professions. Meanwhile, only 4 students (5.9%) did not prefer team-teaching to be incorporated into student's academics.

Generally, the 2 open-ended questionnaire items showed positive responses. Students enjoyed the communication between the teacher and students and the teacher's ability to explain and clear their doubts. Some of the quotes were as follows:

Communication between lecturer and student... where lecturer explains and enquires whether student understand (the context).

All explained clearly and easy to understand. Any questions are answered well...

Explanation was really detailed.

...appreciate teacher effort in explaining everything in detailed... she also allowed us to touch and feel the materials, instead of just explaining.

Moreover, most students wished to have more hands-on activity during the practical session in the future, with some of the quotes stated as:

Can have more hands-on experiment.

Please have more practical session.(More) Hands-on session.

Discussion

The present study aimed to evaluate undergraduate preclinical dental students' perceptions of a cross-professional education using team-teaching in a dental materials science course. In general, students showed positive perceptions of their learning towards team-teaching during the dental laboratory materials practical session. Most of the students agreed that the session encouraged them to learn more about the basic concepts and helped them to identify the basic properties, fabrication processes, and applications of commonly used dental laboratory materials. This allows students to become even more intrinsically motivated to learn dental laboratory materials, as evidenced by the self-determination theory, which consistently correlates intrinsic motivation to higher academic achievement.¹⁴ Moreover, when psychological needs of students are met, motivational assets will be reflected in those assets. As a result, autonomy-supportive teaching increases students' positive classroom performance which is in line with a previous study highlighting that cross-professional instructors or team-teaching can contribute to students' successful learning outcomes.¹¹

Another study examined the impact of using team-teaching and revealed that it is essential for the team teacher to have designated roles, including an expert in the content or pedagogical strategy, to guarantee that active learning among students will take place.¹⁵ Dental technologists are involved in the present laboratory materials practical session for the teaching of dental materials science course. This represents a departure from the previous faculty approach, which primarily relied on teachers with basic dental degrees (dentists by profession). This shift has been prompted by the knowledge and expertise possessed by dental technologists in the field of dental laboratory materials as dentists predominantly focus on the clinical aspects of dentistry. Therefore, it can be argued that both dental technologists and dentists will bring their unique expertise to the table, creating a well-rounded educational experience for the students.

Furthermore, 2 students in the present study perceived that the teaching time allocation for the session is inadequate. The dental materials science course stipulated that each group's time allotment for the laboratory dental materials practical session be fixed at 2 h. One may speculate that since students were exposed to the new teaching method and laboratory dental materials practical session for the first time, they will require more time to learn new information and adapt to team-teaching. Hence, more time should be allocated for the session in the future.

In the present findings, all students agreed that the teacher was knowledgeable and well-prepared for the session. According to the results of a previous study,¹⁶ students' learning satisfaction was most significantly influenced by the teacher. Teachers need to comprehend the course content itself to deliver the information effectively to the students. This is even more pertinent in the current team-teaching setting since dental technologists need to collaborate with dentists and establish a precise division of educational tasks and learning objectives. In addition, the teacher's communication skills are crucial while imparting information and knowledge to the students. More than 90% of the students agreed that the teacher had good communication skills during the session which is also evident from the open-ended responses whereby students enjoyed the communication with the teacher and teacher's ability to clear their doubts. Nonetheless, it is necessary for a teacher to be well-versed with soft skills in order to make the session more interesting and engaging.¹⁷ Teachers need to be able to communicate effectively with their students while also being able to break down challenging subject matter into manageable chunks. It is not surprising that effective communication enhances the teaching and learning environment for the students.¹⁸

Students' motivation, satisfaction, and effective learning are all strongly correlated with how they perceive their learning environment.¹⁹ It goes without saying that a welcoming and relaxed learning environment will influence students' academic learning. Based on the present findings, most of the students felt that the learning atmosphere is relaxed and comfortable for them to ask questions. Students were found to be able to concentrate effectively in learning sessions when the teachers created a comfortable and pleasant learning atmosphere.²⁰ Collaborative team teaching was found to provide a more ideal learning environment for promoting high academic accomplishment because students are given adequate room to broaden opportunities for learning interaction.¹² Although more than half of the students preferred team-teaching to be incorporated into their academics, it is surprising to note that nearly a quarter of students did not prefer to attend the session that is taught by teacher from other allied dental professions (dental technologists) and one-third of them preferred to participate in dental materials science learning activities that are taught by teacher with basic dental degree only. Such a finding contradicts previous studies highlighting dental students showed positive perceptions and attitudes towards collaborative learning with other allied dental professionals.^{21,22} One reasonable explanation for this might be due to the fact that team-teaching is regarded as something new for the students and they were not familiar with it. Another reason could be related to a hierarchical problem, in which dental students may tend to act as though they are superior than their allied dental counterparts.²² However, future studies are warranted to explore the barriers and factors that contribute to it.

Based on the open-ended responses, students wished to have more hands-on activity during the practical session in the future. It has been proposed that hands-on activities created using Kolb's experiential theory improved students' learning outcomes.²³ According to Kolb's experiential theory, learning is the process whereby knowledge is

created through the transformation of experience.²⁴ It involves 4 stages. For instance, during concrete experience stage, students engage in learning activities such as laboratory dental materials practical session. Meanwhile, during reflective observation, students reflect on their experience; and during abstract conceptualization stage, students consider the knowledge they gained through reflections on their experience to identify ways for improvement. Finally, in the active experimentation stage, they use what has been learned for future practice.²⁵ Undeniably, team-teaching gives students the learning opportunity to tackle a particular subject or learning content from an alternative perspective, and this can be a very gratifying experience for the students.²⁶ Findings of the current study can be a stepping stone for dental schools to devise innovative pedagogical strategies such as team-teaching in promoting active engagement among dental students and introducing collaborative learning in the dental curriculum. Nonetheless, several obstacles may arise from implementing an effective team-teaching such as time-consuming due to task distribution, lack of congeniality, and lack of autonomy for teaching.^{15,26}

The present study possesses a few limitations. First, due to the cross-sectional nature of the data collected in the current study, it is challenging to determine the cause-and-effect relationship among the variables. It is therefore not possible to identify factors that affect students' perceptions towards team-teaching in dental materials science course and future qualitative studies are needed to explore this aspect. Hence, large-scale research will enhance the current findings. Second, the present findings cannot be certain that the positive perceptions of team-teaching among students were simply brought about by the new experience in the dental materials science course. Third, it is difficult to generalise the present results to the entire population of undergraduate dental students across the nation as the current study was conducted in a single institution. Moreover, the current institution is the only dental school in the nation to offer a bachelor's degree course in dental technology and to establish a dental technology department teaching staff, rendering it challenging for other dental schools to carry out similar research. It is also important to determine whether such a new teaching method would have an impact on students' academic performances and how teachers who are involved in team-teaching perceive such a teaching method. These attempts will improve team-teaching in Malaysian dental education and elevate it above the existing dominant pedagogical strategies.

In conclusion, this study examined the perception of undergraduate dental students regarding team-teaching in a dental materials science course, where dental technologists were involved in delivering the content. The findings indicated that the students had positive perceptions of this innovative teaching approach. They appreciated the collaborative efforts of teachers from different dental professions and believed it enhanced their understanding of dental laboratory materials. The study also revealed the importance of creating a comfortable and engaging learning environment, which positively influenced students' attitudes toward team-teaching. However, some students preferred traditional teaching methods, and their reasons for this preference warrant further investigation. Overall, this study

suggested that team-teaching can be a valuable addition to dental education, promoting active engagement and diverse perspectives for students. Additional research is required to evaluate the perspectives of teachers and policymakers to generalise the current findings more broadly as well as determine how team-teaching may affect students' academic performance.

Ethics statement

The Asian Institute of Medicine, Science and Technology (AIMST) University Human Ethics Committee (AUHEC) approved the present study with ethical approval code of AUHEC/FOD/2023/17. Besides, all participants gave their informed consent before filling out the survey.

Funding sources

This research received no funding.

Declaration of Competing Interest

The present authors declared no conflict of interest.

Acknowledgments

The authors would like to thank the participants for their time and effort in participating the current study.

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