



Impact of internet supported dental education: Initial outcomes in a study sample

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Abstract

The aim of this preliminary mixed method study was to understand dental students' thoughts on internet supported learning environment (ISLE) and to investigate its' impact on their academic success. The research was designed to enroll the students from the 7th semester of School of Dentistry. The lecturer taught dental students for four hours (within four weeks) on the topics of "anamnesis, extraoral and intraoral examination". Voluntary twenty-four students participated actively to the ISLE. During the evaluation phase, data were collected by using open-ended questionnaire, instructor's observation, students' evaluation forms and exam results. According to the Open-ended questionnaire, 90% of the participating students mentioned e-learning experience positively affected their success; 55% of the students stated that dental courses can be taught online. According to students' evaluation form, the highest mean score was granted to the instructor of the course (4.6/5), followed by the learning environment (4.1/5) and the materials (3.7/5). There was a significant difference between the grades granted to the instructor and materials; students thought the instructor was more important than the teaching materials ($p < 0.05$). It was concluded that ISLE supported by PBL increased the students' satisfaction, positive learning environment and academic success.

Keywords: Online learning; dental education; PBL; internet supported learning; online dental education.

Introduction

In today's dental curricula, traditional educational models have been supported by technology integration via computer or web-based tutorials, use of electronic textbooks, discussion groups, virtual patients and virtual reality-based simulations (Abdelkarim et al., 2014; Al-Jewair, Qutub, Malkhassian & Dempster, 2010; Arevalo et al., 2013; Schönwetter, Reynolds, Eaton & De Vries, 2010). This novel practice has produced a shift in dental curricula towards E-learning, which is simply defined as electronic learning by using a computer to deliver part or all of a course (Schönwetter et al., 2010). E-learning is becoming increasingly advocated to support conventional face-to-face educational activities by facilitating student-centered learning, which has comparable

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efficacy as traditional education methodology (Abutarbush et al., 2006; Camargo et al., 2011; Camargo et al., 2014; Gega, Norman & Marks, 2007; Peroz, Beuche & Peroz, 2009). Additionally, E-learning assists students in being educated according to their needs, supports their personal development and creates positive feelings that increase students' motivation (Al-Jewair et al., 2010). This method also enables efficient use of time (Camargo et al., 2011; Faraone, Garrett & Romberg, 2013; Maresca et al., 2014), individualizes the educational process, and allows the students to work at their own pace and to repeat the educational program as much as needed while reducing the cost required for education (Al-Jewair et al., 2010; Catteau et al., 2013; Maresca et al., 2014).

In many countries, 4 or 5-year dental educational period starts with theoretical courses and terminates with practical ones. Each year, students engage in more practical based courses than theoretical ones. The main issue regarding theoretical information is that it is limited to either lectures or to a textbook which may or may not be required. Additionally, lecture based learning is more of an instructor centered face-to-face environment where learners are passive audiences and all students are expected to process the presented information similarly and learn without the opportunity to review important concepts (Maresca et al., 2014).

Internet supported learning (ISLE) is considered as an accessible, user friendly, cost-efficient and fast system (Anders & Davis, 2010; Catteau et al., 2013). One of the components of internet supported learning environments is "learning management systems (LMS)". Moodle is a member of LMS, and is a very commonly used learning platform designed to provide personalized learning environments for instructors/lecturers and students in a single safe and integrated system. Moodle allows for many activities such as engagement in forums and chat rooms, administration of and grading of quizzes/tests/exams, sharing of documents and images, etc. to facilitate learning and to support the traditional face-to-face classroom setting (Bassir, Sadr-Eshkevari, Amirikhoreh & Karimbux, 2014; Fincham & Shuler, 2001). Moodle seems especially operational in problem-based learning (PBL) that is described as a student-centered learning program which includes problems or cases (Bassir et al., 2014; Fincham & Shuler, 2001). PBL in health education has been investigated worldwide (Smith & Hung, 2016; Nerali, Telang, Telang & Chakravarthy, 2016; Zhou et al., 2016). Since dental education is directly related to human health, it needs a greater exposure to practical education and experience which are sustained under "actual case" simulations, as done in PBL (Bassir et al., 2014). PBL aims to enhance learning by promoting self-direction and problem-solving skills of the students, and also to encourage clinical analysis, critical independent thinking, teamwork, and communication (Bassir et al., 2014; Nerali et al., 2016). PBL has been effective in students' performances, and has led to increased academic success and acceptance into postdoctoral programs (Susarla, Medina-Martinez, Howell & Karimbux, 2003). "Taken together, these findings support potential positive change in "measureable outcomes" for dental education" (Abdelkarim et al., 2014, pg.615).

One of the many issues to be considered in integrating new technologies into the education process is the enormous amount of time and cost (Boddy, 1997; Yip & Barnes, 1999). Therefore, before initiating the integration of new technology based systems into current conventional ones, it is important to understand what dental students think about emerging technologies in their education process and how it affects their success. The aim of this preliminary study was to understand dental students' thoughts on internet supported learning, and to investigate its' effects on their academic success.

Methodology

In this preliminary research, the components of ISLE and PBL have been utilized (Figure 1). This mixed method design research was conducted to collect qualitative and quantitative data for understanding the effectiveness of ISLE in dental education.

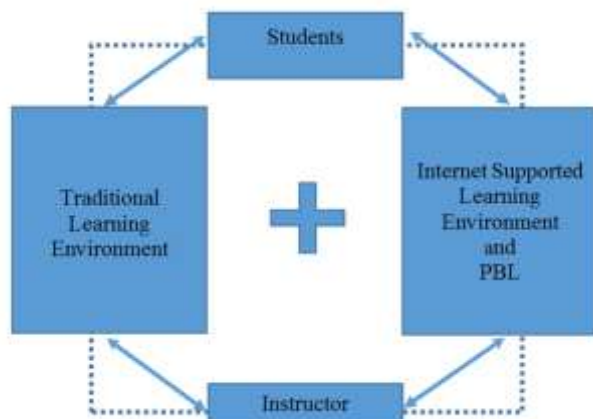


Figure 1. Research Components

The research was designed to enroll the students from the 7th semester of School of Dentistry, who were taking Oral Diagnosis and Radiology courses in 2015-2016 academic year. The lecturer taught dental students for four hours (within four weeks) on the topics of "anamnesis, extraoral and intraoral examination". During the course, the lecturer not only provided the details of these topics in an interactive manner by using real-life patient histories and clinical images on slides, but also asked questions in the classroom, discussed the accuracy of the replies with the students, etc. Usually, the words "why, what else, when, how" were used in order to invoke the students' curiosity to stimulate them to search for the sources to access additional information. In addition, ISLE was created for enhancing the students' learning experiences and Moodle was utilized to deliver course materials and to enrich the classroom conversation online. The reasons for this predilection were that Moodle was quite applicable to (i) support students with additional materials; (ii) create meaningful discussion after the course; (iii) give students an opportunity to improve their knowledge by using online tools; (iv) provide real-life images and videos online; and (v) encourage students to enhance and embellish their learning.

The enrollment of the students was on a voluntary basis after they were informed about the purpose of online forum. There was no punitive action for non-participation, and enrolled students were allowed to use an ISLE environment as an adjunct system to traditional classroom teaching during four months of investigation. Participating students were free to choose their IDs in Moodle.

Online forum discussions were the continuum of classroom conversation, and during four months, all conversations were initiated and led both by the instructor/lecturer and the students. All students (participating in the forum and non-participants) were scheduled for a final exam at the termination of the course. This final exam encompassed all materials presented in the lectures and the anamnesis, extraoral and intraoral examination section was comprised of five open-ended questions. During the exam, the students were informed that they were required to answer any three questions out of those five in that section. Among those five questions, two were similar to the cases/radiographs/topics that had been discussed thoroughly in the online forum. The other questions were related to lectures provided in face to face classroom settings.

Data collection

During the current study, (i) open-ended questionnaire, (ii) students' evaluation form, (iii) exam results and (iv) instructor's observation were used for collecting data (Figure 2).

- (i) Open-ended questionnaire was created by the researchers to understand students' thoughts on seminars and internet supported instruction in dental education.
- (ii) Students' evaluation form was created to understand students' learning experiences considering (a) the instructor, (b) materials and (c) learning environment and to provide scores with respect to their satisfaction with their online course experience by using a

- Likert-type rating questionnaire. (Range of 1-5; 1 = bad experience and 5 = excellent experience).
- (iii) The final exam results of all students were gathered to investigate which questions among the five regarding “the anamnesis, extraoral and intraoral examination” were answered. Also, the impact of this section on the academic scores of the students was examined. The results were compared between students who used and did not use ISLE.
 - (iv) The instructor wrote a journal after each course and presented these observations on the research process and how it affected the teaching experience of the instructor.

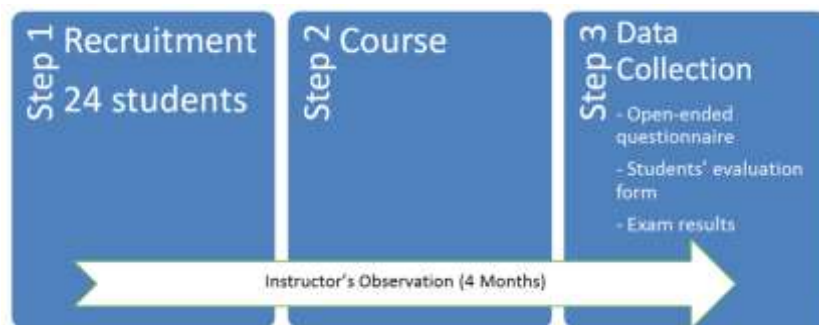


Figure 2. Research Design

Data analysis

Open-ended questionnaire and instructor’s observation were analyzed qualitatively by following content analysis strategies. Also, students’ evaluation forms and exam results were analyzed quantitatively. IBM SPSS Statistics 20.0 software (Chicago, IL, USA) was used for determining the influence of three variables (Instructor, Learning Materials and Learning Environment) on students’ satisfaction by employing one-way ANOVA ($p < 0.05$) followed by Tukey’s post-hoc test.

Results

There were a total of 191 students enrolled in the course with 34 (17.8%) students opting to be enrolled in the online forum. The demographics of the enrolled active online students were 13 females and 11 males, and ages of the enrolled online forum students ranged between 21 and 23 (Table 1).

Even though 34 students registered in the ISLE, 10 students (29.4%; 6 females; 4 males) neither visited the forum, nor viewed the additional teaching materials. Only one student visited the web site to view the presentation provided.

Of 24 students who participated in the forum, 13 students (passive group; 54.2%; 7 females; 6 males) visited the forum but preferred to stay silent and observe the discussions among the students and the instructor. Even though they were passive in the environment, 7 of those students viewed the video (3 students watched twice) and 6 watched the slide presentation (2 students watched twice).

Nevertheless, 11 students (active group; 45.8%; 6 females; 5 males) visited the forum and were actively involved in discussions. In this group, the mean number of total visits to the online environment was 87.7 (range: 4-310), whereas the mean participation to the discussions in the forum was 8.1 (range: 1-16). Among these active students, 3 neither watched the video nor the presentation, but 1 student preferred to watch the slide presentation. The mean number of video watchers was lower than that of presentation viewers (0.82 and 1.27, respectively). Interestingly, in the passive students group, these values were 1.1 and 0.78, respectively.

The highest frequency of visits to online learning environment was in November, which was a month before the midterm exams. Following the exam period, the students used this learning system more infrequently.

Table 1
Active ISLE participation

Students	Gender	visits to forum	participation to interactive discussions	viewing the video	watching the presentation
1	F	310	16	1	5
2	M	240	24	0	0
3	M	162	16	0	0
4	F	128	18	0	0
5	F	53	4	0	2
6	M	45	0	2	0
7	F	34	0	1	1
8	F	33	2	1	1
9	M	26	2	1	1
10	M	21	0	2	1
11	F	19	0	2	2
12	M	18	4	1	3
13	F	18	0	1	1
14	F	15	0	1	2
15	M	14	0	0	0
16	M	7	2	3	1
17	F	6	1	1	1
18	F	5	0	1	0
19	M	5	0	0	0
20	F	4	1	1	0
21	F	4	0	0	0
22	F	4	0	0	0
23	M	3	0	0	1
24	M	3	0	0	0

Evaluation of the learning experience using Moodle environment as an ISLE

In order to obtain the feedbacks from the students regarding their experience with Moodle online learning environment, a questionnaire that includes four questions was asked (Table 2). Of 24 students who participated in ISLE, only 20 students provided answers to the questionnaire.

As presented in Table 2, 75% of participants believed the materials in ISLE were helpful, however 20% of the participants thought that materials should be improved. Participants were asked "What do you think about user-friendliness of internet supported learning environment?" All participants reflected that Moodle as an ISLE environment was easy to use.

Ninety percent of the participating students thought this style of learning experience positively affected their success, whereas one was neutral about this outcome and one did not respond. Furthermore, 55% of the students supported the teaching of dental courses online whereas 40% were not in agreement with this concept.

In order to quantify the views of the students, a Likert-type rating scale (1-5) was utilized and participating students were asked to grade their instructor, learning environment and materials. The highest mean score was granted to the instructor of the course (4.6/5), followed by the learning environment (4.1/5) and the materials (3.7/5).

Table 2
Students' views on ISLE

Students' Views	Positive Views		Negative Views		Requires improvement		N/A	
	n	%	n	%	n	%	n	%
What do you think about materials in internet supported learning environment?	15	75	0		4	20	1	5
What do you think about user-friendliness of internet supported learning environment?	20	100	0	0	Neutral		0	0
Do you think that internet supported learning environment affected your success?	18	90	0	0	Neutral		1	5
Do you think that courses in Faculty of Dentistry can be taught online?	11	55	8	40	Neutral		1	5
					0	0		

There was a significant difference between the grades granted to the instructor and materials; students thought the instructor was more important than the teaching materials.

Evaluation of academic success using Moodle environment as an ISLE

At the end of the seminars, students were required to take a final exam in order to be evaluated for their understanding and comprehension of the materials presented and discussed during the semester. The final exam was graded out of 100 points with 30% of the score related to the seminar discussing anamnesis. Students were asked 5 questions regarding anamnesis with 2 of these questions being specifically related to PBL cases presented in ISLE. Students were given the choice of answering any 3 of the 5 questions.

As seen in Figure 3, ISLE student grades for both the final exam and seminar on anamnesis were higher than students partaking in traditional classroom education. The mean of ISLE students' final grades was 67 out of 100 points and the mean of the anamnesis grade was 23 out of 30 points.

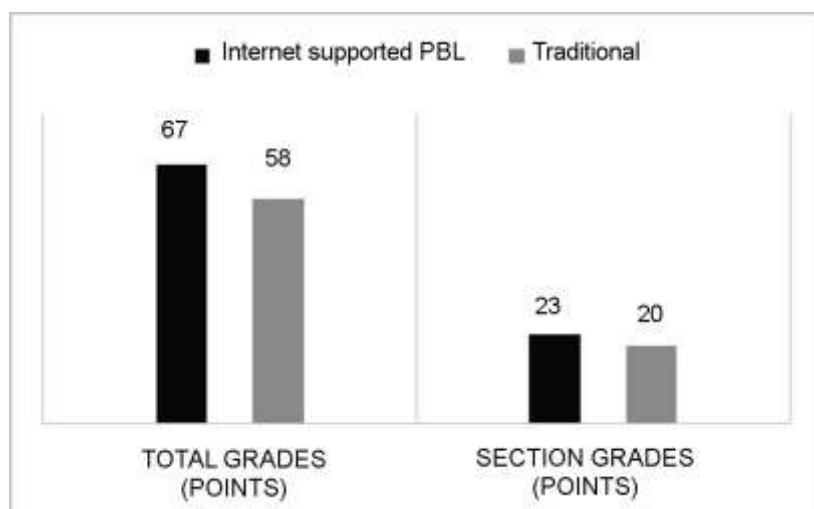


Figure 3. Students Grades

The students who participated in ISLE earned 9 points from questions related to PBL in ISLE and this accounted for 39% of their total success in anamnesis, extraoral and intraoral examination section (Table 3). The students in traditional face-to-face classroom settings earned 6 points from the same questions and this accounted for 30% of their total grades in this section. According to the results, PBL in ISLE positively affected 9% of the students' exam results.

Table 3
Students' academic success

Type of Instruction	Students (n)	Total Grade with maximum score=100 (Mean grade)	Anamnesis, extraoral + intraoral section with maximum score=30 + comprising 30% of Total Grade (Mean grade)	PLB (Mean points) Selective Questions	Effectiveness (%)
Internet Supported PBL	24	67	23	9	39
Traditional	167	58	20	6	30

Instructors View on ISLE

The instructor evaluated the ISLE and reported the results according to pedagogical and technological aspects of ISLE.

In the present LMS amalgamated with PBL model, real-life cases with videos and images were used in an online forum environment, where the discussions between students and instructor contributed to the learning process. The ability to discuss the cases without any time and location limits provided (i) development of effective and closer relationship between students and instructor; (ii) real-time observation of the students' ideas in an online forum environment. The instructor also noted that some students were actively involved in discussions, but others appeared hesitant to get involved due to their unfamiliarity with this learning model.

Even though brief training was provided regarding the use of LMS, including instruction for adding learning materials and conducting forum activities, it was a challenge to manage LMS without any technical support. Another challenge involved the internet connection, which was a must for sustainability of the ISLE experience both for the students and the instructor, but unfortunately, may occasionally get very weak and slow due to service providers.

Discussion

Students' affective responses and instructors' comments are generally utilized as the first step in evaluating a novel system prior to its incorporation into education (Bates, 2004; Willcockson & Phelps, 2010), as was performed in the present study. This step is then followed by quantification of the learning measures (investigation whether novel education model is better than the current one); assessment of the students' ability to transfer the obtained attitude, knowledge and skills to a new condition; and finally, valuation of the students' final performance on any kind of exams, competitions and/or challenges (Bates, 2004; Willcockson & Phelps, 2010). The findings of this preliminary study revealed that only 17.8% of eligible students engaged in an online education option. Of those participants, almost half actively took part in ISLE. However, the remainder preferred to observe the others and endured being silent. It was noted that even the actively involved students did not tend to use the additional learning tools (video and slide presentation). The lower preference of video might be attributed to the language used (English) as some students

may not have been comfortable or capable of managing a foreign language. According to the student's evaluation form, the lowest score within the various categories was assigned to course materials. Nevertheless, the open-ended questionnaire revealed this was not because of insufficiency of the materials but rather due to the demand of the students to have more materials to support their learning process, to enhance their learning and to see more cases on specific topics.

Although many students and faculty found PBL as an important and useful teaching approach (Abdelkarim et al., 2014; Al-Jewair et al., 2010), PBL integration into traditional curriculum has been limited to solitary lectures in many schools (Bell & Hendricson, 1993; Fincham & Shuler, 2001; Walton, MacNeil, Harrison & Clark, 1998), leading to restricted curricular content and confused students who are simultaneously caught between the student-centered vs. instructor-centered educational systems (Bell & Hendricson, 1993). It is suggested that students who are faced with the confusion of different pedagogies. Within the same time frame would more likely focus on the traditional education system which is more comfortable and probably more familiar, rather than the innovative alternative (Woods, 1991). On the contrary, in the present study, all participants had positive attitudes on using ISLE learning. Similar findings were observed in a study wherein it was highlighted that ISLE gave students opportunities to repeat and redo what they learned in the classroom, to access the material wherever and whenever they wanted and allowed interaction between their friends and instructor (Maresca et al., 2014). They also mentioned that materials were supportive to visualize their text based learning and maintain their attentions through the course. Students cited that using ISLE enhanced their learning and aided them in understanding the content knowledge more efficiently since their knowledge on the specific topic was enriched by (i) visualizing their learning process, (ii) encouraging active participation, (iii) providing additional materials and (iv) emphasizing discussion postings. Our findings were similar to those of Kavarella et al. (2012), who stated that 90.9% of the students considered blended learning as a more effective method than conventional one, 91.7% reported higher motivation with blended learning and also performed better in the exam. Likewise, Tan, Hay & Whaites (2009) have reported higher preference of blended education and better academic performance in oral radiology course by the students in King's College London Dental Institute.

There is a lack of information regarding effectiveness of PBL compared to that of traditional systems at a whole curriculum level (Bassir et al., 2014), but comparative studies have disclosed that PBL increases dental students' abilities to acquire real knowledge, to apply it to clinical conditions, and by doing so, to develop their self-confidence as a clinician (Bassir et al., 2014; Mofidi, Strauss, Pitner & Sandler, 2003). Likewise, our students have reported that PBL in ISLE may be used to present samples of "real patients" and contribute to the preparation of dental students to "actual dental practice". Our students' positive approach towards Moodle learning environment could be associated with the utilization of both PBL and ISLE, as highlighted by their answers to the open-ended questionnaire. However, the impact of each one of these factors has not been analyzed in this preliminary study because of the limitations of the sample size. It might be interpreted that the present research model encouraged students to learn in depth by discussing the real-life cases. Additionally, it provided repetitive learning practices in accordance with the students' unique learning tempos. According to the ISLE data of this study, some students read and watched the learning materials multiple times during the course, which is already declared as one of the important advantages of ISLE (Al-Jewair et al., 2010; Kavarella, Tsiklakis, Vougiouklakis & Lionarakis., 2012; Maresca et al., 2014; Tan et al., 2009). This personalized learning environment resulted in meaningful learning, as stated by the participants. Also, in this educational management system, the expertise and experience of the lecturer becomes important because this person is the determinant of the cases which would be used in dental education. The availability of the content, the accessibility of the environment and the expeditious involvement with the forum had also been emphasized by the students. Some declared that using the learning management system eliminates the students' diminished concentration because of scholastic fatigue, which has been reported as an

inherent factor of dental education (Gorter et al., 2008; Kavadella et al., 2012; Pöhlmann, Jonas, Ruf & Harzer, 2005).

Even though the instructor in the present study favored ISLE + PBL learning model, with this shift in education towards integration of ISLE into dental education, many instructors may be reluctant to forego their traditional teaching modalities and may be hesitant to accommodate to this change, probably because of their fear of new technology (Knösel, Jung & Bleckmann, 2011), and lack of proper education in using this novel media and tool in their teaching repertoire (Gardner, 2012). Additionally, the amount of time required for conversion from conventional teaching material to e-learning and design of e-learning modules may be an important concern for the instructors (Tan et al., 2009).

Without preparing the necessary infrastructure (the faculty of information and communications technology departments) to encourage online learning (Beebe, Gurenlian & Rogo, 2014), the ability to promote the participation of the students and instructors to the system becomes a very arduous and difficult endeavor. Therefore, rather than replacing the conventional education system, integration of novel technology into the current instruction has been suggested (Abdelkarim et al., 2014; Kavadella et al., 2012; Moreno-López, Somacarrera- Pérez, Díaz-Rodríguez, Campo-Trapero & Cano-Sánchez, 2009; Tan et al., 2009). Probably the role of an experienced instructor to provide the required knowledge via sharing own experiences, engaging stories and promoting creativity may be considered for this suggestion. Accordingly, E-learning may be improved by the instructors who maintain an interactive communication with the students thereby guiding them in finding solutions and providing feedback (Reich et al., 2007). It has been already shown that contemporary students' motivation is associated with external sources such as the instructor or other classmates rather than inner drive (Winning & Townsend, 2007). In the present study, the students granted the highest scores to the instructor during their ISLE experience. This finding might be interpreted as (i) students enjoyed their instructor's teaching skills and the means by which strategies were delivered, because the instructor implemented a PBL approach by using real-life cases; (ii) students paid more attention to the discussions with the instructor in forum environments than solely learning with materials, and students engaged with reading and/or writing on forums more than viewing the materials; (iii) students were taught both online and face-to-face by the same instructor, so this familiarity made them more comfortable in focusing on the instructor more than the learning materials. Our findings agreed with the literature and highlighted the importance of the educator in Moodle education management system.

Rather than knowledge gain, the translation of this knowledge into clinical practice shall be evaluated (Al-Jewair et al., 2010). Catteau et al. (2013) have reported increased efficiency in clinical outcome after E-learning. Our findings showed that dental students had an increased performance in exams after participation in the present education module. Even though the students enjoyed the combination of online and face-to-face learning and found this model to be effective, most students thought the existing conventional dental education system should not be replaced by ISLE; rather, a PBL+ISLE approach should be applied as a complement to the traditional model. However, as suggested by others (Al-Jewair et al., 2010; Willcockson & Phelps, 2010) evaluation of other outcomes, including diagnostic accuracy, knowledge retention and translation of knowledge into dental practice should be also considered in future studies.

The effectiveness of ISLE was evaluated in this investigation by implementing it as a single course intervention in a lecture-based curriculum, as was done previously (Albanese & Mitchell, 1993; Eaton & Reynolds, 2008; Kavadella et al., 2012; Reynolds, Mason & Eaton, 2008; Zhang et al., 2012). However, the actual efficacy of ISLE can be evaluated more accurately when it is used in a curriculum-wide system (Gupta, White & Walmsley, 2004; Reynolds et al., 2008). Thus, this point may be considered as a limitation of our study. The other limitations are the short duration of the study and the small sample size. Although four months of investigation may be adequate to implement the study, longer duration might affect the students' adaptability to ISLE and subsequent educational satisfaction. The small size is the result of voluntary participation, but

obligatory enrollment was avoided in order to prevent the biasing of the results. Additionally, this was the first exposure of the ISLE experience for the students and the faculty, hence, they were unfamiliar with this study design and probably because of their inexperience, they may have been more hesitant and reluctant to join the discussions in the online forum.

Conclusion

Students advocated the implementation of PBL+ISLE into dental face-to-face education and found this model effective in improving self-motivation, self-study and self-assessment. They mostly enjoyed the function of the instructor in their learning experience and the incorporation of PBL into their educational process. However, students did not favor replacement of conventional dental education by ISLE; rather, they suggested the integration of it with conventional dental curricula. Additionally, Moodle as a learning management system provided real-time information regarding the (i) students' participation, (ii) contribution, (iii) performance and (iv) interaction with the system during this research process.

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