Incorporation of Project-based Learning into an Occupational Health Course

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Abstract: Incorporation of Project-based Learning into an Occupational Health Course: Alireza Dehdashti, *et al*. **Occupational Health Department, Faculty of Health, Research Center for Social Determinants of Health, Semnan University of Medical Sciences, Iran**—**Objective:** Use of an appropriate teaching approach is a major concern for faculty members who are involved in occupational health and safety academic education. The challenge is to explore teaching tools to equip students with knowledge and skills to prepare them for their practices, in which they will encounter occupational health and safety issues in various occupational settings. The current study presents the design and implementation of a team project-based learning approach for undergraduate occupational health students to examine the appropriateness and perceptions of students and educators with regard to such a learning experience. **Methodology:** Steps were taken to guide the educators and students through the learning process based on projects completed in teams. The research tools for collecting data were a questionnaire and semi-structured interviews with participants. **Results:** The results illustrated that use of the proposed teaching approach as part of occupational health education may have the potential to motivate and enhance the active roles of educators and students in the learning process, and improve students' technical and social skills that are crucial for practice in the occupational health field. **Conclusions:** The study findings showed that project-based learning may provide a promising teaching strategy in the education and training of occupational health students. In addition, academic institutions should encourage educators to plan, introduce and evaluate the effectiveness of project-based learning.
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Education is a systematic and planned approach to improve the acquisition of knowledge and skills to achieve desired objectives. Many enterprises have complained about university systems, pointing out that higher education focuses excessively on theoretical instruction rather than practical training, which may result in insufficient ability for conducting research, lack of specialized knowledge and weakness in teamwork activities[1]. The adaptation of teaching and learning approaches to current social demands is a challenge in academic environment[2,3]. It is necessary for tutors to evaluate their teaching approach and, in doing so, help to provide an efficient learning environment for students to prepare them for their future professional demands and responsibilities[4,5]. Accepting responsibility, critical thinking[6], working in teams and willingness to collaborate and engage in self-directed learning[1,7] are among the expectations and graduate attributes of students that must be addressed by academic institutions to prepare them for their future careers.

In Iran, education and training of students in the field of occupational safety and health are carried out by academic institutions. Educators are responsible for teaching undergraduate students, who are expected to acquire a knowledge base and practical skills so that they can perform a broad variety of technical procedures to anticipate, recognize, evaluate and control various workplace hazards in order to play a critical role in industrial and occupational settings. Most occupational health educators prefer to use traditional lecturing as a common way method of conveying information to students. However, reviews of the literature on lecturing as a teaching method have shown that despite lectures being as effective as other methods in presenting information and providing

explanations, they have limitations. Knowledge building by students in classes based on lecturing rarely progresses beyond the exchange of information[8, 9] and practical skills are not obviously taught[10, 11]. When organizing occupational health and safety education in an academic environment, which is different from the environment in working life, it would be useful to integrate practical parts of education in the curriculum and in the teaching of different subjects[12].

A number of studies have already suggested project-based learning as an appropriate means of acquiring effective knowledge in higher education[13–16]. The philosophy embedded in project-based learning is that students learn more by applying knowledge that is familiar to them as well as new information toward resolving a problem. Project-based learning is a method that intends to develop learning by allowing learners to build knowledge through learning and application of projects that are real and relevant to the subject being studied[17, 18]. Furthermore, the model not only makes the connection between theoretical information and practice, but also enables students to reflect on their own learning[19] and to initiate brainstorming, discussions and identification of learning issues[20, 21]. The models integrating project-based learning have their scientific basis in generating learning processes in which students are not passive recipients of knowledge[15] and practically investigate solutions to a problem[18, 22]. They build their own knowledge by active learning, interacting with the environment, working independently or collaborating in teams, while the teacher directs and guides learners in order to make a real product[23, 24]. Studies that have applied project-based learning in higher education contexts indicated that it gives students exposure to education in a manner that is both fun and motivating, whilst promoting the knowledge through connection with a real-world application[25, 26]. In addition, skills such as cooperation and teamwork can be developed through project-based learning which cannot always be developed by students in a traditional classroom environment[21, 27, 28]. Briefly, the model allows students to apply their ideas while engaging in real-world activities through investigating questions, hypotheses, discussion and developing solutions[12, 29].

The purpose of this study was to examine the appropriateness of integrating project-based learning experience as an instructional tool in an undergraduate-level occupational health apprenticeship course. The current paper describes the structure of project-based learning and the perceptions of the students and faculty with regard to such a teaching approach, which may be used as a guideline in teaching occupational health and safety issues to students.

Methodology

A combination of quantitative and qualitative research was used to examine the effectiveness of the group project-based learning in teaching undergraduate occupational health students.

Procedure and participants
The first three years of academic education in the Department of Occupational Health at the Semnan University of Medical Sciences in Iran serve as a platform that will give students an overall view of occupational health and an extensive knowledge of appropriate facts. The department requires all senior-level students to take an apprenticeship course as part of the educational program in their last academic year. The participants in this study were 51 students (32 females and 19 males) and four educators who participated in the experiment at Semnan University of Medical Sciences over the course of 17 consecutive weeks during the autumn academic semester. Course sessions were held three days per week for a total of 6 hours per week. Instruction for the course took place through classroom and on-line discussion, and the course was purposively selected for the study in that it compromised project-based learning activities. Students were divided into 17 manageable tutorial groups of 3 students each. The primary goal of the course was to improve students' learning and practical skills needed to deal with occupational safety and health problems in real work environment situations through a project-based learning approach.

Implementation of the learning process
In our study, we designed and planned five steps to guide educators and students through the project-based learning process. These steps are summarized in Table 1.

Table 1. Main steps in the project-based learning approach

Step 1	Forming project group
Step 2	Planning research project: selection of topics, defining learning goals
Step 3	Project implementation: determining activities and tasks, design and data collection, determining due dates
Step 4	Project presentation and submission
Step 5	Project evaluation

Instructors made an initial presentation in class, and then the students designed and developed projects relating to various aspects of occupational safety and health. We assigned the students in groups so that they would participate in a collaborative learning process in which they would solve real problems as a team. We activated students' need to know by planning visits to workplace settings, videos and classroom discussions that engaged their interest and initiate questioning and set up scenarios. We made arrangements to visit and perform occupational safety and health projects at five manufacturing companies. First, educators outlined and carried out a preliminary study focused on occupational health and safety issues by workplace and then performed walk thorough visits together with students. Instructors asked students what they were interested in so that they could motivate them to get involved in the learning process. Instructors led students in brainstorming possible work-related safety and health problems to create study projects. After discussions and encounters with work environment safety and health issues, student teams generated a list of objectives, questions and hypotheses. Assisted by instructors, the student teams began planning what tasks they would perform and how they would work together. As the students worked on their projects, instructors encouraged each team to regularly review how well they were collaborating, communicating and using technical aids. The same teams of students met regularly throughout the academic semester, in which they worked on a series of predefined projects. Furthermore, the students had access to laboratories to run experiments. Students were encouraged to consult each other and senior students, teaching assistants and faculty staff. Each team presented the progress of their work, and instructors guided the students and led discussions during regular class sessions. Formative and summative evaluations were performed through oral presentation and a written essay. Instructors coached students in preparing and presenting their projects. At the end of the course period, each team was required to prepare and submit a final report detailing the research and development process and the conclusion. We evaluated this project-based learning experience through pre- and post-project surveys and by peer evaluation by the students and instructors.

Data collection

Prior to commencing the course, we asked students to indicate whether they had experience with projects and their views about the keys to successful projects as well as difficulties they may encounter. Data were collected through semi-structured interviews and questionnaires administered to each student and faculty member that focused on their thoughts, feelings and actions at the end of the semester. At the end of the course, students completed a survey in which they indicated their general satisfaction, advantages and drawbacks with regard to the group project. We asked them about the obstacles they faced and their recommended solutions for improving the project-based learning process. Grading rubrics were used to assess students' perceptions concerning the project-based learning, rating them on a Likert scale. We considered and classified students' perceptions of "strongly agree and agree" in one category and "disagree and strongly disagree" in another. The proposed items in the questionnaire were based on the study purposes, a literature review with regard to project-based learning and the comments of faculty members involved in occupational health education.

Results

Table 2 shows our post-project survey questions and statistical data for students' responses indicating their perceptions towards project-based learning at the end of the experiment. It could be inferred from Table 2 that based on our post-survey the majority of the students stated that they enjoy working collaboratively, as they may benefit from collaborative learning by obtaining new knowledge and information and practical skills from their peers and also by completing their research project. Teamwork was included by most students among the strengths of the course. Students believed that performing a research project in occupational settings and discussion with workers may enhance their social skills. Moreover, learning based on Project learning may encourage self-directed learning. When asked about possible future activities, around 80% of the students expressed that they are confident of their ability to perform a research project. The results indicated that 81% of the participants recognized that teamwork encouraged investigating further sources of knowledge. In general, students were moderately satisfied and felt good about their project-based learning experience and evaluated it as motivating and interesting. Despite frequent comments suggesting the ability of the project to develop skills to manage conflicts within the groups, some students felt differently with regard to their ability to manage conflicts.

The virtual learning environment as practiced in project-based learning process did not satisfy most of the students. Around half of the students replied that they were not satisfied with on-line discussions with faculty members. In our post-project interviews, students mentioned that it was difficult to lead a proper on-line discussion with faculty members. In Particular, they realized that the on-line discussions

Table 2. Students' perception about project-based learning experience

	Disagree/strongly disagree	Neither	Agree/strongly agree
Communication skills			
I developed my ability to communicate effectively with others	13%	21%	66%
I improved my ability to convey ideas	21	7	72
Critical thinking			
I developed my ability to make judgments	14	39	47
I became more willing to consider different points of view	3	17	71
I have been encouraged to use my own initiative	18	32	50
Interpersonal skills and cooperative learning			
I learned to make decision based on discussion with group members	7	14	79
I learned to manage conflicts within group	22	10	68
Working in a group helped me to develop work skills	16	11	73
Working with students encouraged me to investigate further sources of knowledge	6	11	83
I improved my social skills during meetings with employers and workers in a company	1	9	90
Workload			
The amount of work expected to do was reasonable	9	44	47
I had enough time to do tasks and complete the requirements of the project	13	40	47
Virtual learning			
Faculty members provided proper access to on-line materials students needed	13	29	58
On-line discussions were valuable for maintaining contact between students and faculty members	48	22	29
Self-learning skills			
I can take responsibility for my own learning	5	20	76
I became more confident of my ability to pursue further learning through research projects	3	15	82
General			
I improved my ability and knowledge to solve problems in occupational health and safety	3	18	78
Project did not take too much of my time	35	23	42
Working on a research project in a group was better than working alone	2	13	85
I found learning based on projects interesting and motivating	2	9	89
Project represented real occupational health tasks	8	39	64

were more superficial than in-classroom group meeting discussions. Students reported that they spent much more time on their research project than traditional courses based on lecturing.

As shown in Table 3, most of the students indicated that the ability to cooperate and improve communication were essential attributes to learning through a teamwork research project. Equal distribution of work among team members, commitment, good planning, flexibility and openness to other's ideas were considered important attributes required for a successful group project learning experience.

Interviews revealed that uneven distribution of project work (23%), difficulty in agreeing on a topic (16%) and inadequate time to complete tasks (15%) were challenges perceived by some students in the project-based learning experience.

In interviews with the instructors who participated in the experiment, all agreed that project-based learning allowed them to observe students both individually and collectively as they exchange and clarify information among themselves. The instructors observed better involvement of students in learning activities, students' enhanced depth of knowledge and life skills including communication and oral and written presentation skills as the benefits of project-based learning methodology. Two instructors stated that the experience allowed them to train students to think about and use new methodologies to perform research projects. Instructors also reported insufficient cohesiveness within the groups and students' overwhelmed work as noticeable challenges throughout the course.

Discussion

The aim of this study was to examine the impact of project-based learning in training occupational health students. We evaluated both the students' and faculty members' perceptions of project-based learning included in an undergraduate occupational health curriculum.

In Iran, students at the undergraduate level with no professional experience are admitted through a comprehensive entrance exam. For students with little or no previous experience from working life, a successful curriculum in occupational safety and health should provide possibilities to spread out theoretical education and include practical training in the courses[12]. We introduced our instructional approach based on the integration of project-based learning into a course to design and improve the curriculum. Throughout the process, instructors helped students to define projects to examine occupational stressors. The application of project-based learning to the occupational health curriculum requires preparation of instructors and students as well as careful planning. The tutor's role in project-based learning is different from traditional direct-instruction methods depending lectures and textbooks[9]. Previous researchers have identified important dimensions of tutor performance that stimulate the learning process in project-based learning[19, 20]. Instructors should recognize their role as facilitators and provide a flexible learning environment for project-based learning, and students need to take responsibility for their own learning. Faculty should help students to focus on significant aspects of the project. In order for students to work productively, faculty members must balance the need to

Table 3. Students' perceptions about elements crucial for group project success

Factors	%
Collaboration	86
Communication	81
Contribution	21
Commitment	16
Planning	15

allow students to work on their own with the need to maintain order. Furthermore, faculty members had to put great effort and time into helping and guiding the students besieged with assignments and had to organize their time to complete tasks. Some have found that students are frustrated by the lots of time and effort needed to meet the requirements in a project-based learning course and recommended integrating lectures into project-based learning[18, 25]. Having the tutor take the facilitator or guide role is not the way that most tutors were taught to teach. Therefore, teachers who use a project-based learning approach may have to adopt new instructional strategies to overcome the obstacles.

Students demonstrated their ability to work together to identify, formulate action plans and to resolve work environmental health and safety problems. The results have led us to realize that collaboration is an important element of project-based learning. Previous study has shown that a learning approach based on a teamwork project helped low-ability students to demonstrate initiative, management and teamwork as they worked in groups[6]. Students also enjoyed the learning process because it gave them opportunities to interact with their fellow students and make new friends through cooperative projects[21, 22]. However, group efficacy and self efficacy were found to depend largely on the quality of the group process[27]. Effective collaboration among students requires more than involvement; it requires exchanging ideas and negotiating meaning. In the course of team project-based learning, students may face conflicts in intra group discussions and making decisions. As a part of project-based learning, negotiation is required to collectively find solutions to problems. Previous research suggested that collaborative learning through projects provides a learning environment so that students can learn with and from each other[7]. We learned that most of the students learned to work successfully with other students in their group. Previous research reported favorable impacts of project-based learning on particular groups of students. Students with low verbal ability and little previous content knowledge

learned more in project-based learning classes than in traditional classes[28].

Several researchers highlighted that involvement of students in projects with real objectives has an effect on the learning of skills students require for future careers[5, 9]. Although some students disagreed that the project course improved their knowledge with regard to studying occupational health and safety problems, the majority of our students commented that the research project enhanced their understanding of concepts and knowledge. In principal, the project work provided them with the opportunity to actively perform an investigation which resulted in learning concepts and applying information in dealing with occupational safety and health issues. This suggests that practical aspects of the project assisted students to obtain technical expertise to deal with occupational safety and health problems in the work environment. Students' perceptions implied that the project-based learning environment encouraged the promotion of self-directed learning, as the students showed their readiness to take responsibility for their own learning and to investigate sources of knowledge not taught in the classroom. This finding is in agreement with a survey of project-based engineering education reporting that the development and learning of engineering theory and practical skills could not be taught in a classroom-based curriculum[29].

Previous studies suggested that students undergoing a project-based learning experience have a tendency to develop greater understanding of a subject, higher level reading and increased motivation[6, 20, 23]. This claim is acceptable by most of the students, as about 89% admitted that project work was interesting and motivating, and resulted in a feeling that they could play an active role throughout the learning process.

Meanwhile, the project-based methodology may encourage students to study realistic occupational health tasks in an educational setting, and through this process, students are able to bridge the gap between academic settings and industrial settings[9, 14]. Therefore, the project-based learning approach may be more meaningful to students if they come from work settings. This result, which more than half of the students admitted that the project was a true illustration of real occupational health problems, suggests that the nature of the project work allows students to study meaningful, real situations. In our research, the projects were designed so that our students could study actual occupational health and safety problems in work environment; therefore, the learning process was not limited to classroom lecturing and discussion, and students had to deal with "real-life" occupational health and safety problems. This result is supported by other engineering students' views, which indicated that such a project gave them a perception of exposure to a real engineering work style[4, 5].

Students were able to establish good communication with employers and workers while doing activities in industrial settings. The structure and requirements of any practical project concerning occupational health and safety problems in work settings necessitate the use of such skills, which are keys to the success of the project. According to Bell (2010), students require skills that will assist them in becoming productive members of the global society in modern times.

Our experience indicated that the students evaluated face-to-face meetings as being more effective than online meetings, with students mentioning that it was difficult to have a proper discussion. Apparently, students would rather hold their questions and comments for face-to-face sessions. Compared with virtual learning interaction, the speed of negotiations is much faster in the classroom with verbal interaction. This difference may indicate that virtual learning restricts the flow of communication within groups forcing students to reflect their views in classroom discussions. However, there is increasing interest in virtual classroom programs, and a previous study indicated that in designing virtual project-based learning courses, students' experience with the methodology and prior agreement to a specific time frame and schedules are important[24].

Conclusions

The findings of this action research are based upon the perceptions of students and faculty members engaged in a project-based learning methodology for training occupational health students. Both teachers and students expressed the opinion that project-based learning improved the active roles of teachers and students throughout the learning process and enhanced team working and communication skills. Project-based learning as a teaching strategy may effectively convey concepts related to occupational safety and health issues and prepare students for real problems they will encounter as graduates in work environment health. Students' involvement in real work environment problems does appear to cause them to be more independent and take greater responsibility for their own learning and self-directed learning, which is an important outcome in occupational health education. It is worthwhile for faculty members to carry out and allocate their experience to support the integration of project-based learning approach into occupational safety and health syllabuses and to examine in more details student perceptions of their own learning achievements and the reliability of the reported effects to improve project-based learning in teaching occupational health.

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