

# Explaining Medical Students' Experiences on the Implementation of Team-Based Learning in Medical Semiology Course

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## Abstract

**Background:** Today, innovative and active teaching methods such as Team-Based Learning (TBL) have attracted the interest of a large number of accrediting bodies, educators, and administrators. In this regard, exploring students' experiences and opinions to identify the benefits and challenges of these methods will help in the better and more effective use of these methods.

**Objectives:** Considering the above, this study attempted to explore the lived experiences of general medicine students regarding the implementation of TBL in the medical semiology course.

**Methods:** This study employed a qualitative approach and a descriptive phenomenological study to achieve its objectives. Data were collected through semi-structured interviews, with data saturation achieved after 10 interviews. The data were analyzed using the Colaizzi method.

**Results:** Data analysis revealed 187 initial codes, 33 subcategories, and 11 categories. The categories included: developing soft skills in students; continuity of learning; peer learning; the teacher as a learning facilitator; preparing for future teamwork; learning through formative assessment and feedback; attending active and dynamic of students in class; deep and sustainable learning; creating a favorable learning atmosphere in the classroom; challenges and limitations of implementing TBL; solutions for enhancing the quality of TBL. The findings indicated that the three categories — “preparation for future teamwork”, “creating a favorable learning atmosphere in the classroom”, and “developing soft skills in students” — had the highest frequency and codes.

**Conclusion:** The findings of this study demonstrated that the benefits and achievements of TBL outweigh its challenges and limitations. Nevertheless, it is essential to ensure its proper and planned implementation with adequate supervision. In addition, preparing and empowering instructors is crucial to ensure the success of this method and other interactive approaches.

**Keywords:** Education; Teaching; Student; Medicine; Medical

## Background

Choosing an appropriate educational method to enhance learning and skills in medical students is of importance (1) and significantly impacts their learning outcomes. Nevertheless, evidence demonstrates that the predominant method in medical education is lectures.

In this learning approach, students receive a large volume of information from the instructor, which typically does not result in deep learning, causing rapid forgetting and fatigue, with insufficient opportunities for discussion and Q&A (2, 3). Researchers believe that a significant portion of the ineffectiveness of the

university education system emanates from the lack of student engagement in participatory activities (4).

In this context, innovative and active educational methods have garnered attention from various accrediting bodies, including general medical accreditation, educators, and administrators. In these methods, the learner's interests and abilities are at the center of focus, with the instructor striving to boost learners' skills and creativity. Various studies have discussed the benefits and drawbacks of each method. For instance, a study of postgraduate students indicated that interactive teaching methods can improve performance both in soft and hard skills. According to students, the use of these teaching methods resulted in deeper learning, the development of critical thinking, and enhanced motivation (5). Thus, by applying active teaching methods and enhancing the quality of teaching and learning, students' creative talents are also affected (6).

*Team-Based Learning (TBL):* One such active learning method is Team-Based Learning (TBL) (7, 8). The TBL method was implemented in 1998 by Dr. Michaelson to boost student motivation and engagement in active learning (9). This educational approach plays a key role in ameliorating problem-solving skills, interpersonal communication, and critical thinking (10). Team-Based Learning (TBL) is aligned with Vygotsky's constructivism theory and the influence of the social environment on the learning process. Vygotsky's theory encourages cooperative and collaborative learning between students and faculty members or peers (11). TBL also establishes an active and participatory learning environment, emphasizing individual and team accountability, group interaction, and motivation for participation in group discussions (12).

This method adheres to four essential principles: i) forming and maintaining groups, ii) holding students accountable for individual and group work, iii) providing timely feedback, and iv) designing team assignments to reinforce learning and team development (12). Numerous studies have explored the effectiveness of this method. For example, a study by Xie et al. indicated that use of the TBL method could enhance learning while ensuring student satisfaction. They stated that TBL education is compatible with current medical education and should be generalized to more classrooms (13). A scoping review by Sterpu et al. suggested that most published studies reported positive outcomes about student satisfaction and engagement in TBL. Nevertheless, the results were inconsistent across the knowledge domain. They stated that no definitive conclusions could be drawn about the value of

implementing TBL for clinical disciplines. Thus, they recommended that further studies with rigorous methodologies be conducted (14).

*Team-Based Learning (TBL) in Iranian Medical Classes:* In Iran, the team-based learning method was officially considered for the revision of the medical curriculum at Tehran University of Medical Sciences in 2011. The aim of this program was to include a student-centered and integrated approach into the medical curriculum. Thereafter, it was considered in other universities as a class teaching methods, research projects, as well as teaching and learning scholarship (15).

Recently, owing to educational accreditation visits and the emphasis of standards on student-centered learning, the demand of a new generation of students (Z generation), consideration of student-centered approaches during the revision of medical science curricula, and support of the medical education study as well as development centers of universities in empowering professors to implement TBL, a suitable background has been provided at the national level for the implementation of interactive teaching approaches such as TBL.

*Implementing TBL in the Medical Semiology Course:* Given the above information, it is expected that by employing appropriate methods for teaching various courses and units, we would witness an improvement in learners' academic progress. Semiology (clinical signs) is one of the most significant courses in general medicine in Iran, which is part of the second stage of the four-stage general medical curriculum known as the pathophysiology phase. This educational stage lasts for one year and includes pharmacology, specific pathology, along with various internal medicine courses alongside semiology. According to the approved curriculum from 2017, this course needs to be undertaken in both theoretical and practical formats (training in skill labs or simulation centers). The semiology course serves as a bridge between basic science and clinical science to understand the signs and symptoms of disease as well as accurately diagnose and differentiate diseases in the Iranian medical curriculum. In the semiology course, students become familiar with skills in patient history taking and examination (16). Further, in this course, students should be trained in clinical reasoning, communication with the patient during history taking, and examination.

The Iranian medical curriculum also emphasized teamwork, group discussion, group assignments, and small group practice. Despite the importance mentioned, according to the researchers' studies, this

course at the Sari Medical School is mainly presented in a combined form, that is, in-person and virtual, with an emphasis on theoretical content. Based on the feedback of learners from previous courses, traditional methods based on theoretical content caused learners to become weak in clinical reasoning. Moreover, the level of peer interactions, teamwork skills, and motivation to learn decreased in them. Therefore, considering its constructivist learning philosophy, TBL is appropriate for teaching these subjects and can be a suitable answer to the above-mentioned issues.

In addition, the General Medical Accreditation Standards have emphasized the interactive teaching methods along with the development of communication and teamwork skills. Thus, the TBL method was employed to teach the medical semiology course in the first semester of the 2023-2024 academic year. Accordingly, a team of instructors (general internal medicine faculty and medical education specialists) designed and implemented the course based on TBL steps over several sessions with the presence of the Vice Dean of General Medicine.

Initially, students were grouped into teams of 7 to 8 based on their GPAs. Subsequently, after introducing the course plan, necessary information regarding this method was provided to students, where the educational content (including MP4 files of important points from each chapter of the textbook, along with educational images) was made available to students via a virtual network one week before each session. At the beginning of each session, a multiple-choice quiz (consisting of 15 to 20 scenario-based questions) was administered. The quiz questions were drawn from the main course content and were designed to be sufficiently challenging to encourage group discussion among team members. Following the individual quiz, the same quiz was administered as a team test. Along these quizzes, students discussed the questions within their teams, referring to the material they had previously studied to justify their answers and defend their responses. Following the quiz, team members could fill out an appeal form if they disagreed with the answers or how the responses were written. Next, with the participation and guidance of the instructor, feedback was provided for 25 minutes. Subsequently, all groups were assigned the same task, which involved designing a scenario based on the points learned in class. In this phase, students were allowed to use resources, and ultimately, they assessed their teammates. For the practical part of the course, training on examinations was performed on simulated patients in a workshop format at the medical

school. Previously taught topics were practiced on a simulated patient who was healthy in every respect. Students were also asked to implement the techniques taught by the instructor on each other to familiarize themselves with examining that organ in a healthy individual. This phase was supervised by instructors across three stations, whereby necessary examination tools such as stethoscopes, sphygmomanometers, tuning forks, monofilaments, etc., were provided to the students. After completing the theoretical topics in the medical school, students, in coordination with the education department, attended the internal medicine ward in small groups to learn about abnormal cases.

Since evaluation of any educational program is essential to ensure its quality, it is important to identify the strengths and weaknesses of the course from the perspective of its main stakeholders. Hence, exploring what students have experienced firsthand in the semiology course based on the TBL approach will help in making decisions to modify or continue the above approach. In addition, it also provides valuable information for national and international researchers and planners to use team-based teaching methods for teaching history taking and medical examination, as well as future program planning.

### Objectives

Regarding the above, the current study aimed to explore the experiences of general medicine students considering the use of the Team-Based Learning (TBL) method in the medical semiology course at Mazandaran University of Medical Sciences.

### Methods

**Study design:** This applied research was undertaken as a qualitative study based on a descriptive phenomenology method. The participants in the study included general medical students in the first semester of the 2023-2024 academic year, who were selected via purposeful sampling with maximum variation regarding GPA, age, gender, and accommodation status. The inclusion criterion for participants was being present in the medical semiology class utilizing the TBL approach, while guest and transfer students with incomplete or minimal experience were regarded as exclusion criteria.

**Instruments and Data Collection:** Data were collected through semi-structured interviews. The interviews took place in a quiet location at a suitable time for participants, coordinated and approved in advance. Before initiating the interview, information on the study design was provided to the participants in the form of a

study information sheet, and their informed consent was secured. The interview guide consisted of open-ended questions that were developed through a review of literature and in consultation with an expert on the topic. Content validity of the instrument (interview guide) was determined by three experts (one PhD in medical education and two medical students). Prior to the interview, each participant was assigned a code. At the beginning of the interview, the purpose of the research was explained, and permission was obtained to record and take notes along the interview. The participants were also assured that their information would remain confidential and that the interview data would be published anonymously.

Next, the four main questions were asked (Table 1). The initial question was linked to participants' general impressions of the interactive teaching methods, such as TBL. Subsequently, follow-up questions were also employed for specific aspects (such as experiences regarding TBL in the semiology course, advantages, and probability challenges). The average duration of each interview was between 30 to 45 minutes, varying based on the responses of participants. Also, probing questions were asked when necessary to extract richer, more detailed narratives. Interviews were performed when participants were physically and mentally prepared and patiently answered questions. At the end of the interview, appreciation and thanks were expressed for their cooperation. The interviews were recorded in full, with important points also noted. Next, within 24 hours, the recorded conversations were transcribed verbatim. The interviews continued until the extracted data became repetitive whereby no new data emerged, reaching the point of data saturation.

**Data analysis:** For data analysis, the Colaizzi method was utilized, following seven steps to achieve the objective (17). In the first step, at the end of each interview and after recording field notes, participants' recorded statements were listened to repeatedly, and their remarks were transcribed verbatim by one of the researchers (M.B.). In order to understand the feelings and experiences of the participants, the text was read multiple times by two of the researchers (A.Z. & M.B.). In the second step, after reviewing all participants' descriptions, meaningful information associated with the phenomenon under discussion was highlighted by the same two previous researchers, thus identifying key sentences. The third step involved extracting formulated concepts, where an attempt was made to derive a concept from each statement that represented the meaning and essential part of the individual's thinking.

It was also ensured that the relevance of the formulated meanings to the original statements was investigated to confirm the accuracy of the connection between them. Once the codes were extracted, the researchers carefully studied the formulated concepts and categorized them based on their similarities. This way, thematic categories of the formulated concepts were established. The next, based on the results of step four, a complete and comprehensive description of the phenomenon was written, creating broader categories. In the sixth step, a comprehensive description of the phenomenon under study (as clearly and unambiguously as possible) was provided. The researchers (A.Z. & M.B.) sent two other researchers (N.M. & S.M.) a copy of the results for validation and confirmation of the consistency between these categories and descriptions, whereby similar results were obtained. In the seventh step, through returning to each participant and conducting an individual interview, participants' opinions on the findings were solicited, with the final validation and accuracy of the findings carried out. The analysis process example is displayed in Figure 1.

To ensure the accuracy and robustness of the data, the four criteria of Guba and Lincoln were considered: credibility, confirmability, dependability, and transferability. For obtaining credibility, prolonged engagement and interaction with participants as well as an appropriate time for interviews, peer debriefing, and member checks were employed. For transferability, a comprehensive description was provided about participants' characteristics and study context. Further, purposive sampling was utilized in the current study. To obtain conformability, reflexivity and audit trail was used along with reviewing the codes and categories extracted by two medical education experts (peer check). For dependability, all study details and information were described extensively to be easily audited by other researchers (inquiry audit).

## Results

In this study, data saturation was achieved with a total of 10 interviews. Since in qualitative studies, data analysis is performed concurrently with the data collection process, the results of the analysis revealed that the emergence of new data diminished from the seventh interview onwards, and most of the participants' conversations were repetitive. No new data were extracted after interviewing 10 students, leading to thematic data saturation. In addition, two follow-up interviews were also conducted to ensure that no new information was added to the findings. Most

participants were non-native (70%) and had an average age of 22 years (40%). The mean GPA of participants in the study was 16.32 (Table 2).

Through the analysis of the interview texts, a total of 187 initial codes, 33 subcategories, and 11 categories were extracted. The categories are as follows: Developing soft skills in students (including five subcategories: strengthening clinical reasoning and creativity, increasing self-confidence, strengthening critical thinking skills, developing communication skill, practicing the leadership role); Continuity of learning before, during, and after class (including four subcategories: the evolutionary path of learning, creating mental preparation through pre-reading the material, repeatedly reviewing the material, consolidating the material through assignments); Peer learning (including two subcategories: learning through teaching, practicing teaching skills); The teacher as a learning facilitator (including one subcategory: reversal of the teacher's role); Preparing for future teamwork (including three subcategories: improving the morale of consulting, improving the ability to cooperate and work in groups, dividing tasks and promoting responsibility); Learning through formative assessment and feedback (including two subcategories: learning through feedback, learning through individual and group tests); Attending active and dynamic of students in class (including two subcategories: activating silent students, providing opportunities for active participation); Deep and sustainable learning (including three subcategories: correcting misunderstandings and mistakes, comprehensive understanding of the material, reviewing learning key points); Creating a favorable learning atmosphere in the classroom (including six subcategories: managing and redirecting classroom mischief and jokes, reducing educational anxiety, creating competition and motivation in learners, suitability of student seating format, positive impact of catering in the classroom); Challenges and limitations of implementing TBL (including three subcategories: time-consuming and energy-consuming this method, requires follow-up and monitoring, limitations of using TBL); Solutions for enhancing the quality of TBL (including three subcategories: TBL implementation requirements in the semiology course, the necessity of integrating TBL with other teaching methods, suitability of this method for interactive courses such as history taking and physical exams) (Table 3).

The data analysis indicated that some categories and subcategories played a more prominent role in the interviews owing to their higher frequency. In general, the three categories "preparation for future teamwork",

"creating a favorable learning atmosphere in the classroom", and "developing soft skills in students" were more emphasized by students and were the most frequent, claiming the highest number of codes. Thus, they played a pivotal role in the final shaping of the experience. Further, the three subcategories of "improving cooperation and teamwork ability", "dividing tasks and promoting responsibility", and "creating competition and motivation in learners" were emphasized by all participants (10 people).

For example, P2 stated about "developing soft skills in students": *"The main stage happened in the classroom itself. This was the reasoning and challenges that occurred in response to the scenarios. This is far more important than just reading and listening to the lesson. For me, this method was very effective."*

P1 stated about the category of "creating a favorable learning atmosphere in the classroom":

*"In routine classes, students would spend their energy and time joking with others. But in the TBL class, the same energy and time were dedicated to learning and feedback. The same jokes in routine classes were hidden here in the form of exchanges between groups"*.

P4 also stated about the category of "preparation for future teamwork": *"Medicine is more collaborative, meaning that in a clinical setting, there are different people, such as patients, residents, fellows, etc. So there is teamwork. I think this method is pretty much in line with what happens in a hospital setting."*

Nevertheless, the codes related to the three subcategories of "activating silent students", "managing and redirecting classroom mischief and jokes", and "the time-consuming and energy-consuming nature of the TBL method" were emphasized less by the participants (three participants) compared to the other subcategories.

For instance, P10 stated about the category of "the time-consuming and energy-consuming nature of the TBL method": *"This method is time-consuming because the students are not very familiar with this method, and it takes a lot of energy for them to adapt to it"*.

P5 highlighted the category of "activating silent students": *"When I looked at the other groups or teams, I noticed that some of the silent students in other classes were talking more here and expressing their opinions. Overall, there was a more dynamic atmosphere than in regular classes."*

P8 stated about the category of "Managing and redirecting classroom mischief and jokes": *"In TBL classes, there was no mischief or frequent class absences, since all teams focused on discussing and exchanging ideas to answer the questions correctly."*

Further, by combining the findings of [Table 2](#) and the demographic characteristics of the participants in the class, it was determined that the subcategories related to "activating silent students", "Managing and redirecting classroom mischief and jokes", and "increasing self-confidence" were more frequently expressed by male students. The subcategories "the necessity of integrating TBL with other teaching methods" and "requires follow-up and monitoring" were more frequently emphasized by students with high GPAs.

*Participant P6 stated: "TBL is very good for courses and lessons such as history taking and general subjects, but for courses like physiology and hematology, which are extensive and there is no time to explain all the details... it is better to integrate it with other teaching methods".*

*Participant No. 7 stated: "If there is no follow-up and supervision, this method is useless because students will show up to class unprepared, which is useless."*

## Discussion

This study aimed to explore the lived experiences of medical students considering the implementation of Team-Based Learning (TBL) in the medical semiology course. Through analyzing the interview texts, a total of 187 initial codes, 33 subcategories, and 11 categories were extracted. Some of these categories and subcategories pertained to the achievements and advantages of TBL, while others addressed the challenges and limitations of this method.

The findings of our study are in accordance with theories of interactive learning, such as Vygotsky's theory. This theory emphasizes social interactions along with the role of the teacher as a facilitator in the learning process (11). The experiences of the participants in the current study also highlighted these two issues. Further, the learners in the current study emphasized the role of peers in their learning and the consolidation of their learning, which is in line with the concept of Vygotsky's zone of proximal development (ZPD).

The researchers of the current study believe that this is owing to the characteristics of the learners, the skilled and team-based nature of their future job, as well as the educational environment of medical universities. This signifies that we are faced with learners in medical universities who need team interactions to undertake their roles and tasks. At the same time, they are more inclined to practice medicine independently. Thus, they expect their professors to play a facilitating role.

A review of the existing literature in this field suggested that various studies, both domestic and international, have explored the benefits and

achievements of the TBL method across different educational groups and levels. Although some of these studies have compared this method with other approaches, others have utilized it to design their classes and courses. For instance, Loncher et al. used TBL as a framework for interprofessional education in patient safety. According to their study, significant advancements were observed in "communication and teamwork" as well as "interprofessional learning." (18). This method was also well-received by students, concurring with the current study's findings regarding readiness for teamwork in the future and the creation of a favorable learning environment in the classroom as well as their subcategories. Ulfa et al. compared the impact of TBL and lecture-based learning on clinical reasoning and class participation. Their findings revealed that the clinical reasoning scores of students in the TBL group were higher than those in the lecture group, positioning TBL as an effective learning method for boosting students' clinical reasoning abilities and facilitating more independent and active learning (19). Elsewhere, having researched application of TBL for medical students, Jost et al. demonstrated that those in the TBL group significantly outperformed the other group in evaluating key characteristics of problems, thereby improving their clinical decision-making skills. These findings align with the category of developing soft skills and continuity of learning (before, during, and after class) (20). The results of Yang et al.'s study revealed that TBL improved participants' comprehension and enhanced their skills in assessing as well as meeting community needs. A comparison between the experimental and control groups demonstrated that the TBL group exhibited significantly greater performance, learning attitudes, and nursing competencies than the traditional method group. The findings of this study correspond with the extracted codes from the category of readiness for teamwork in the future (21).

Smeby et al. compared the TBL method with the lecture method for third-year medical students, reporting that students in the TBL group had a higher level of participation and satisfaction. They also noted that the understanding of challenging materials as well as the ability to engage in class and provide and receive feedback were higher in the TBL group, which is in accordance with the findings of the current study across various categories and subcategories (22). Branney et al. inspected the use of TBL in teaching applied pathophysiology to undergraduate nursing students. According to their study, student satisfaction was over

92%, with 76% of students preferring the utilization of TBL. Further, most participants expressed a strong desire to have meaningful participation in teams, whereby a clear connection existed between learning activities and teamwork experiences (23).

All of the above studies are consistent with the current study. The difference is that our study focused on the lived experiences of learners, whereas other studies have mainly been quantitative and based on comparisons with other teaching approaches. Thus, our study is complementary to other studies.

Cremerius et al. conducted research to explore the influence of TBL on teaching musculoskeletal ultrasound skills compared to peer-assisted and conventional education. The results indicated a significant rise in theoretical knowledge for all students ( $p=0.001$ ), and the performance of TBL learning groups was significantly higher in OSCE compared to others ( $p=0.001$ ). This study demonstrated that TBL was superior to peer-assisted and conventional teaching methods (24). This study contrasts with the current one, as our findings suggest that peer learning is one of the advantages of the TBL method. In other words, peer learning is part of the approach and cannot be compared in isolation. Indeed, in the TBL method, the peer learning component is integrated with other techniques such as team formation, group work, feedback, and so on, boosting its overall effectiveness.

Nevertheless, since the current study implemented TBL for a large class (N:56) and without prior experience of implementing TBL, two categories emerged related to the challenges and limitations of TBL, which are considered as the contradictory and challenging data of the present study. In these two categories, the following were emphasized: the need for supervision and follow-up to prepare learners in advance, their active participation in team discussions, and completing homework after class.

The challenges and limitations of implementing TBL identified in this study have also been observed in other studies. For example, Liu et al. addressed the challenges and strategies related to developing team-based learning in medical education in China. They found that less than half of the medical schools in China utilized TBL in basic medical or internship courses. Among these, only 10% reported using TBL in both internship and basic medical courses. Their findings indicated that general awareness of TBL, infrastructure and executive support, professional training, resource sharing, and the integration of various disciplines are vital, which also discussing factors for facilitating the application of TBL.

These findings align with the extracted codes in the categories of challenges and limitations of TBL implementation, as well as strategies for boosting TBL quality (25). In a study by Haley et al., which compared TBL and case-based learning among third-year dental students in the United States, the findings revealed that participants preferred case-based learning over TBL; however, the scores of students in the TBL group were higher than those in the other group. This study also demonstrated that, considering the development of resources and content, there were more infrastructures for the CBL method. Nonetheless, in TBL, instructors and students spent more time together. The findings of this study correspond with the current study regarding the necessity of integrating TBL with other teaching methods, as well as the time-consuming and energy-intensive nature of this method (26).

One of the limitations emphasized by participants in the current study was the time-consuming and energy-intensive nature of TBL. In the study by Smeby et al., modified TBL sessions were utilized to address the challenge of time consumption. In this approach, initial readiness tests were eliminated to shorten the class teaching time by half, allowing more time for clinical problem-solving. According to their study, shorter sessions may facilitate the implementation of TBL in the curriculum and allow for more frequent sessions, thus enhancing satisfaction with this method (22). In the current study, the participants suggested that TBL should be integrated with other approaches, particularly traditional ones, to save time and energy. Nawabi et al. also explored the integration of TBL with PBL in a package format for teaching dental students. Based on their study, students reported the positive aspects of the TBL experience as a more engaging format, collaborative learning, teamwork, and group competition. They stated that PBL ameliorated their research, presentation, and clinical reasoning skills. While they generally favored TBL, students ascertained the new PBL-TBL package as an optimal learning approach, which contrasts with the findings of this study emphasizing integration with traditional methods (27). One reason for this could be the learners' experiences; generally, the students participating in our study, being in the early clinical stage, had mostly been taught through traditional approaches such as lectures and Q&A sessions. They, therefore, had limited experience with PBL and other interactive teaching approaches, and TBL may have been the first structured and organized method they encountered. This could have influenced their positive experiences and outlook.

Thus, when deciding to use interactive and active approaches in medical classes it is recommended that policymakers, educators, and educational designers, pay attention to issues such as empowering students and professors to employ this method through holding workshops, examining the nature of the lesson or course in terms of the feasibility of implementing interactive approaches, consulting with educational experts, the number of students, and classroom space and facilities. In cases where it is not possible to fully implement this method, they should modify it by applying educational design models and integrating this method with other teaching methods.

In addition, since the TBL method was implemented for the medical semiology course, and this course confronts similar challenges such as a large number of students and a short semester in most universities, the findings of the current study can be generalized to other medical schools for the semiology course with some adjustments based on the context and facilities of the course. Further, given the recent policies of Mazandaran University of Medical Sciences regarding the use of interactive approaches in teaching, it can also be generalized to other theoretical and practical classes.

**Limitations:** One of the limitations of the current research was the rather small statistical population in Mazandaran University of Medical Sciences and Sari Medical School. Further, the experiences and opinions of course instructors were not considered, which is another limitation. Finally, even though all interviews were conducted by a trained interviewer who had no previous experience in using TBL, other limitations of the current study included a small sample size and positive bias from the interventionists.

### Conclusion

Overall, this research indicated achievements and advantages as well as challenges and limitations of TBL that included developing soft skills in students; continuity of learning-before, during, and after class; peer learning; the teacher as a learning facilitator; preparing for future teamwork; learning through formative assessment and feedback; attending active and dynamic of students in class; deep and sustainable learning; creating a favorable learning atmosphere in the classroom; challenges and limitations of implementing TBL; and solutions for enhancing the quality of TBL. The findings of this study elucidated that for the success of TBL, both students and instructors play an important role, and it is necessary to prepare instructors in different courses, and they should be empowered to use

interactive teaching approaches as well as motivate students. Based on the findings of the current study, it is recommended that future research plan, implement, and ascertain the effectiveness of this method in the clinical stage as well.

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**Conflict of interests:** There is no conflict of interest.

**Ethical approval:** This research was approved by Mazandaran university of Medical Sciences Research Deputy (designed Code: 21911; ethics code: IR.MAZUMS.REC.1403.354). The research was carried out in accordance with guidelines and regulations stipulated in the Declaration of Helsinki. For participants' consent, we inserted written consent in the information sheet, with all participants giving informed consent before answering the questions. This written consent included information about confidentiality, data storage as well as audio recording security protocols (assignment a code to each student, permission to record the interviews or take notes from it). Participation in this study was voluntary.

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**Table 1.** The interview questions

The interview and probing questions
1. In your opinion, is the use of interactive teaching methods such as Team-Based Learning necessary in medical classes? Please explain.
2. Please share your experiences regarding the use of the Team-Based Learning method in the semiology course.
3. What challenges and advantages did you experience in implementing the Team-Based Learning method?
4. In your opinion, what outcomes has this approach achieved for learning? Please explain.
To accomplish the research objective, guiding questions were utilized. The guiding questions for the interview were as follows:
1. Can you provide an example if possible?
2. Could you elaborate more if possible?

**Table 2.** Demographic Characteristics of Participants in the Study

Participant Code	Gender	Age	Native or non-native	GPA
P1	Male	21	Native	16.15
P2	Male	23	Non-native	16
P3	Female	23	Native	15.6
P4	Male	26	Non-native	15
P5	Female	23	Non-native	16.5
P6	Female	22	Non-native	18.20
P7	Female	22	Non-native	17.90
P8	Male	22	Native	16.70
P9	Female	22	Non-native	16
P10	Male	22	Native	14.32

**Table 3.** Analysis of interview text and extracted codes

Categories	Subcategories	Codes
Developing soft skills in students	Strengthening clinical reasoning and creativity	Strengthening clinical reasoning if the educational process continues with this method. Higher level questions required more reasoning. Strengthening clinical reasoning in students through asking case-based questions. Strengthening creativity in problem solving.
	Increasing self-confidence	Increasing self-confidence in students. Strengthening self-confidence in students to ask questions and communicate with professors. Increasing self-confidence during individual exams. Developing courage in the student's personality.
	Strengthening critical thinking skills	Strengthening the spirit of criticism. The possibility of criticizing each other's opinions. Paying attention to differences of opinion by re-reading the topics. Hearing the different opinions of the students. There are many differences of opinion in every subject because everyone thinks in a unique way.
	Developing communication skills	Strengthening communication skills in students. Developing interaction and empathy skills.
	Practicing the leadership role	Practicing leadership roles in groups. Increasing leadership power and managing conflict, pros and cons, and challenges. Choosing someone as a leader and team leader in each team. One person in the group became the leader. Practice leadership during teamwork.
Continuity of learning (before, during and after class)	The evolutionary path of learning	The learning period from before class to after class was formed for students. Pre-class path clarity. Step-wise learning. Student-centered and evolutionary learning path. Continuity of learning from before class to after class.
	Creating mental preparation through pre-reading the material	First, we read the contents ourselves and had a common mindset. Gaining an overview of the material due to previous study and pre-reading. Prerequisites stated before the first session. Mental readiness to accept new material. Creating an overview of the content before class. Pre-reading before class helps to learn faster.
	Repeatedly reviewing the material	Learning was more active through review, repetition, and challenge. Consolidation of material in long-term memory through review. Re-summarization of material repeatedly. Learning involved multiple stages and was repetitive. We were actually reviewing in class. Learning through writing and checking several times.
	Consolidating the material through assignments	Continuing learning after class through homework. Better consolidation and recall of material. Reviewing material through homework.

Peer learning	Learning through teaching	<p>Learning from classmates in groups.</p> <p>Smarter students learning from weaker students in some specific cases.</p> <p>Providing the opportunity to learn from stronger students in groups.</p> <p>Providing the opportunity to learn from peers.</p> <p>Learning through teaching a group.</p>
	Practicing teaching skills	<p>Students being teachers to their friends.</p> <p>Practice teaching skills in students.</p> <p>Everyone taught the student at their own level of knowledge.</p>
The teacher as a learning facilitator	Reversal of the teacher's role	<p>The role of the teacher as a facilitator or challenger.</p> <p>The teacher as a learning facilitator.</p> <p>The change in the teacher's role compared to the traditional classroom.</p> <p>The appropriate approach of teachers and away from strictness.</p>
Preparing for future teamwork	Improving the morale of consulting	<p>Strengthening the spirit of consultation among students.</p> <p>Providing opportunities for consultation experience.</p> <p>Talking and consulting between groups at times.</p>
	Improving the ability to cooperate and work in groups	<p>Practicing preparation for teamwork in the clinic.</p> <p>Improving students' ability to cooperate and work in groups.</p> <p>Suitable grouping of students.</p> <p>Practice and repetition for medical teamwork for future performance.</p> <p>Creating balance in work teams.</p> <p>We were discussing within the group.</p> <p>Eliminating doubts and challenges during group work.</p> <p>Practice speaking, gathering information, and working on challenges in teams.</p> <p>Unintentionally guiding students to interact.</p>
Preparing for future Teamwork (continue)	Dividing tasks and promoting responsibility	<p>Creating a sense of responsibility due to the formation of a new work group, regardless of routine friendly groups.</p> <p>Student-centered teaching and giving students responsibility for learning.</p> <p>Students in groups could not easily say "I can't do it" and shrug.</p> <p>Positioning strong and weak students together in groups.</p> <p>Division and creation of new work groups.</p>
Learning through formative assessment and feedback	Learning through feedback	<p>Providing feedback to make education interactive in this method.</p> <p>Completing the learning gaps through feedback from teachers.</p> <p>Preparing students to receive feedback.</p>
	Learning through individual and group testing	<p>Learning through questions and answers.</p> <p>Self-assessment through individual testing.</p> <p>Learning through group testing.</p>
Attending active and dynamic of students in class	Activating silent students	<p>Dynamic and active silent students in the classroom.</p> <p>There were students who were silent and did not speak in normal teaching methods, but in this method, they spoke and had active participation.</p> <p>Active presence and not sleeping in class.</p>
	Providing opportunities for active participation	<p>All students participate in the TBL class from the beginning to the end.</p> <p>Involving all students.</p> <p>Encouraging other students to participate and learn through activity.</p> <p>Participating all students in the discussion.</p>
Deep and sustainable learning	Correcting misunderstandings and mistakes	<p>Awareness of flaws, errors, and misunderstandings.</p> <p>Learning through mistakes.</p> <p>Going back and reviewing and correcting mistakes.</p> <p>Having the opportunity to search and use references simultaneously in class.</p>
	Comprehensive understanding of the material	<p>Recounting mental blind spots in TBL.</p> <p>Helping to understand the subject.</p> <p>Learning more and not just relying on the teacher's material.</p> <p>Opportunity to use the Internet and mobile learning to understand the material.</p> <p>Consolidation of the learned material.</p>
	Reviewing Learning key points	<p>Learning the main and key points.</p> <p>Our learning was also increased.</p> <p>Preparing the background and reviewing the main content in class.</p> <p>Helping students reach a level of mastery in key content.</p>

Creating a favorable learning atmosphere in the classroom	Managing and redirecting classroom mischief and jokes	Turning class jokes into group discussions. Directing class mischief in a positive direction. Incorporating humor and fun into the teaching process of our friends.
	Reducing educational anxiety	We didn't have much stress. Our anxiety was greatly reduced. Decreased class anxiety and answering questions during class. Reduced stress on test night.
	Creating competition and motivation in learners	The existence of hypothetical competition. The class was enjoyable. No feeling of fatigue. Improvement of motivation to learn in students. Increasing motivation of students by creating competition to solve questions. Competition is a double motivation for learning. Creating interest in students to continue the class even despite previous fatigue.
	Suitability of student seating format	The appropriateness of the students' meeting format for group interaction and discussion. The seating and class model was similar to European universities.
	Positive impact of catering in the classroom	Students' interest and excitement in being entertained during class Reception during the class as a strength. The good reception during the class.
Challenges and limitations of implementing TBL	The time-consuming and energy-consuming nature of the TBL method	The need for a lot of time and energy. This method is time-consuming and energy-consuming. Dedicating more time to teaching educational challenges.
	Requirement of follow-up and monitoring	The need for the teacher to follow up on students' homework. The need for supervision of students' previous study and their participation in groups.
	Limitations of using TBL	Inability to implement for all sessions and all lessons. TBL not applicable for memorization lessons. High number of students per entry. The method should be integrated and combined with the traditional method.
Solutions for enhancing the quality of TBL	TBL implementation requirements in the semiology course	The need to specify the algorithmic state of the class before implementing the method. The need to prioritize topics and assign the TBL method to priorities. The need to complete courses before implementing TBL for the semiology class. The need to develop and use a self-assessment checklist. The need to train based on more common cases. The need to create a culture for this method from the early years of the general medical course.
	The necessity of integrating TBL with other teaching methods	The method should be integrated and combined with the traditional method. I think this method should continue for the semiology course in a combination with the previous method. For easier lessons, it should be lecture and traditional, but for more practical issues, we should use this method.
	Suitability of this method for interactive courses such as history taking and physical exam	A course like history taking is good. History and physical exam which is an interactive course where you have to interact with the patient. For internal medicine courses can be very good.

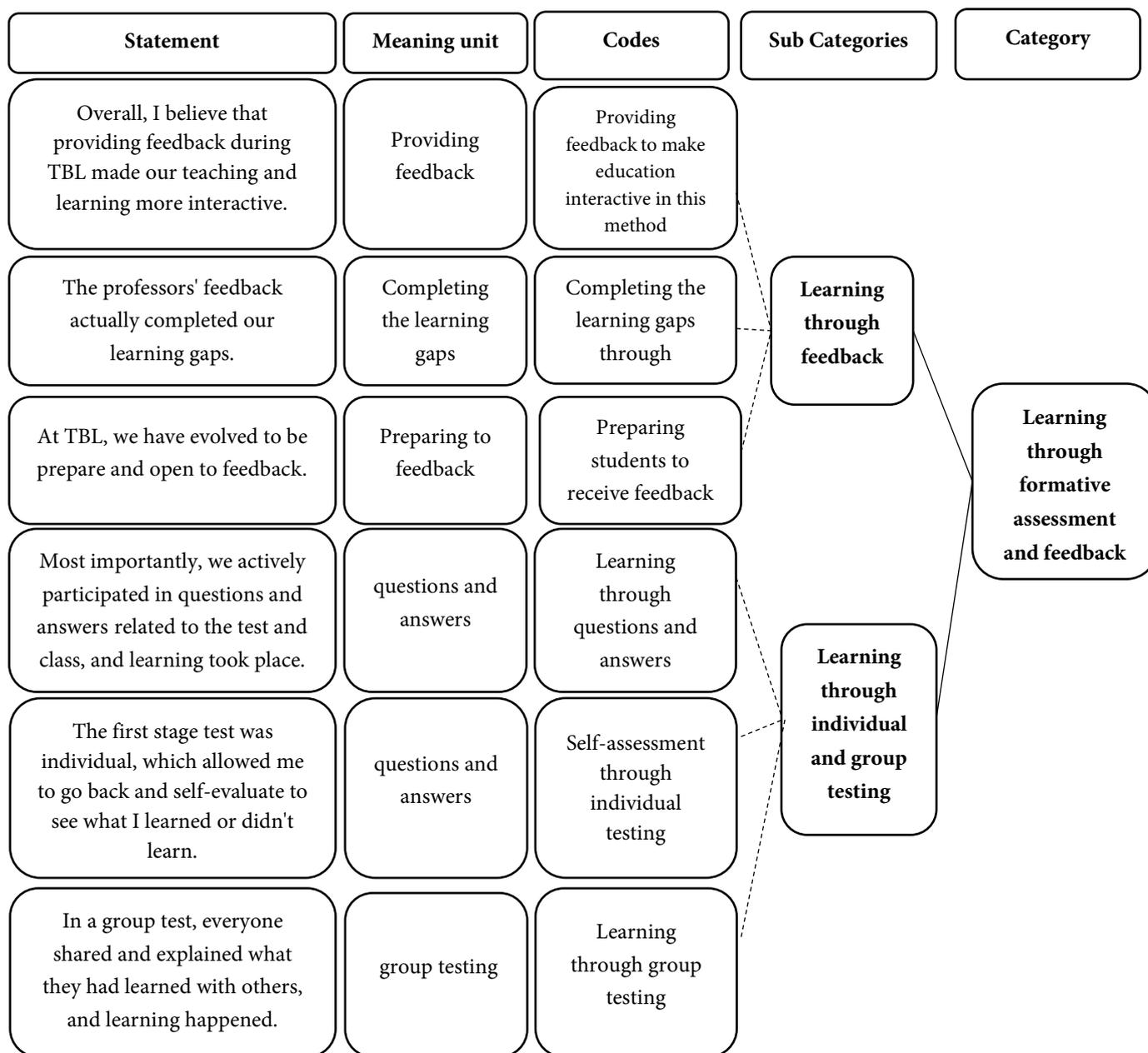


Figure 1. An example of the analysis process related to the category of “learning through formative assessment and feedback”