



Student-Centered Learning in the Anatomy Laboratory: Medical Students' Perspective

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Abstract

The teaching of anatomy has for long been delivered through lectures and supplemented with laboratory sessions that are predominantly delivered by faculty members. In this study, we aimed to assess the benefits of medical students' student-centered learning (SCL) approach in the anatomy laboratory. First-year medical students were invited to participate in this study. Information about the study was provided to the students and informed consent was obtained. In one laboratory session, students were divided into groups and were provided with a list of structures that they need to identify on prosections using the available resources. This was followed by a faculty-led learning session (FLL) to identify the same list of structures. Students were then asked to complete a questionnaire at the end of the laboratory session evaluating the benefits of incorporating SCL into their learning. Anonymized data was collected and analyzed using Statistical Package for Social Scientist (SPSS). From the 86 registered students, 65 took part in this study. Medical students preferred FLL session when it comes to consolidating anatomical knowledge, remembering new anatomical knowledge, and developing in-depth understanding of anatomy and their ability to ask questions regarding challenging topics. Meanwhile, students' preferred SCL session when it comes to helping them stay focused, providing a more relaxed learning environment, enhancing communication with peers, and developing independent learning skills. In this study, we highlight the benefits of incorporating SCL in the anatomy laboratory complemented by FLL. With the clear benefits of SCL, further research is required to investigate the best way to integrate similar sessions in an anatomy laboratory and its impact on student performance.

Keywords Anatomy · Education · Student-centered learning · Learning environment · Learning skills

Introduction

The word anatomy is derived from the Greek words “ana” (meaning up) and “tome” (a cutting) and when combined “ana temnein” means “cutting up” [1]. As a discipline, anatomy has existed for thousands of years and has been referred to as the cornerstone of healthcare and medical education [2–4]. One of the oldest methods that have been used to teach

anatomy is through cadaveric dissection. Dissecting a human cadaver usually complements didactic anatomy teaching lectures that precedes the practical, hands-on learning process [5]. A study conducted in the UK where 580 medical students were surveyed across two medical schools agreed with the anatomists' views that dissection is the “most fit” educational resource in the study of anatomy [6]. Therefore, it seems that the use of cadavers remains a crucial component in the understanding of the human anatomy.

During the latter part of the twentieth century, the discipline of anatomy has encountered several challenges which led to many changes in teaching methods. Some of these challenges included reduced teaching time, diminishing tutor numbers, and increasing medical student intake [7]. Moreover, the genesis and evolution of the digital age in recent times welcomed various information and communication technologies and medical schools adapted to this new environment by incorporating such technologies into their teachings [8]. The incorporation of new technologies and teaching methodologies has

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revolutionized this discipline in recent times and raised the question on whether computer-assisted learning can replace the use of human cadavers to learn anatomy [7].

With this decrease in the number of hours dedicated for anatomy teaching, several medical schools are using prosected human material instead of cadaveric dissection [7, 9]. Teaching using prosections requires shorter class hours than teaching using dissections, thus making prosection more efficient and effective in teaching anatomy [10–12]. However, despite the changes that medical schools have gone through, the debate about the use of prosections versus dissection continues.

Some of the recently used methods to teach anatomy includes enquiry-based learning, problem-based learning, and collaborative learning which includes learning from colleagues (peer teaching). In these situations, students play the role of the “teacher.” This is referred to as student-led learning (SLL) or peer learning (PL). SLL has been described as valuable, effective [13], and substantially beneficial [14] for both the student leaders and tutees. In addition, sessions led by peers have also been viewed as a learning opportunity, a strong motivation and inspiration for learning not only among the students but also for faculty members and residents [15]. Peer teaching comes in various forms including peer-assisted learning (PAL), near-peer teaching (NPT), team-based learning (TBL), reciprocal peer teaching (RPT), and self-directed learning (SDL) [13, 16–19]. Many of these teaching methods can be described as student-centered learning (SCL) approaches.

Meanwhile, faculty-led learning (FLL) is characterized by a dominating presence of an academic member of staff/faculty member who is guiding or delivering the learning outcomes [19]. This is opposite to SCL where students play a more active role in the learning process and are responsible to take more initiative in the process. In this type of learning, students are not completely left alone but have access to facilitators and are provided with the necessary resources. An article by Brueckner and MacPherson mentioned some drawbacks of SCL or in this case near-peer-led tutorials including the notion that peer leaders may not know the material as well as faculty, potentially leading to students mistrust in the accuracy of the information presented to them [20]. In this study, we aim to investigate the benefits of student-centered learning in the anatomy laboratory as a complementary approach to the currently used FLL approach.

Material and Methods

Study Design

First-year graduate entry to medicine (GEM) students at University College Cork (UCC) were invited to participate

in this study. Information about the study was provided to the students and informed consent was obtained. The anatomy laboratory learning experience is divided into four 25-min sessions. The first session follows the FLL model and is dedicated to learning anatomy using prosected human material delivered by a faculty member, with 4–6 students in every session. The other three sessions are running simultaneously where students are performing different learning activities using models, computer, or microscopes [21]. For the purposes of this study, the first session was divided into two parts. The first part was a 15-min SCL session, where the students were asked to identify a list of structures using the available resources. This was followed by a 10-min FLL tutorial. At the end of the laboratory, students were provided with a questionnaire to gather information on their experience.

Questionnaire

The questionnaire was divided into several sections. The first section included demographic questions targeted at the participant’s background. In the second section, the students were asked about their experience in the SCL and FLL sessions. In this section, students were asked to rate several statements based on their experiences in both sessions on a 5-point Likert scale with 1 being strongly disagree and 5 strongly agree. In the third section, students were asked about the advantages and disadvantages of both sessions, while providing them with an opportunity to suggest changes to improve both sessions.

Statistical Analysis

Data was anonymized and personal identifiers were removed. The anonymized quantitative data was collected and entered manually into Microsoft Excel spreadsheets. Answers to the open-ended (qualitative) questions were entered manually on word document and thematic analysis was used to identify different themes. Frequencies of both “strongly agree” and “agree” were analyzed as one category similar to “strongly disagree” and “disagree.” Quantitative data was then exported to GraphPad Prism, version 6 (GraphPad Software Inc., San Diego, CA) where chi-square goodness of fit test was used to determine the *p* values for different statements related to FLL and SCL.

Ethical Approval

Ethical approval was granted for this project by the Social Research Ethics Committee (SREC) at University College Cork on the 11th of April 2018 under log number 2018-023.

Results

Background

A total of 86 first-year Graduate Entry Medicine (GEM) students were enrolled in the course with 65 students taking part in the study yielding a 75.6% response rate. Questions 1 to 6 were associated with quantitative data while questions 7 and 8 were related to qualitative data (open-ended questions). Results of this first part revealed that 37 female and 28 male students took part in this study. The largest student age group were in the bracket of 24–26 age ($n = 29$ students) groups, followed by 20–23 ($n = 24$), then 27–30 ($n = 8$), and the least was those in the bracket of 30 years old ($n = 4$).

The anatomy class is made up of both Irish ($n = 23$) and various international students from Canada ($n = 30$), the UK ($n = 5$), the USA ($n = 3$), and other nationalities ($n = 4$). Most students had a science degree ($n = 52$) followed by non-science degrees ($n = 16$) and “other” was the least in number ($n = 3$).

Learning Environment

When asked about their ability to stay engaged throughout the teaching session, 71.9% of medical students agreed that the SCL session provided them with this opportunity with the difference being statistically insignificant to FLL. Moreover, there was a significant difference between students who felt that they were better able to concentrate (stay focused) on the material covered in the SCL session ($n = 48$) compared with FLL session ($n = 33$). The number of students agreeing and disagreeing to these statements is represented in Table 1.

An equal majority of students (70.8%) disagreed that either teaching methods provided a stressful learning atmosphere. Meanwhile, when asked whether this type of learning offered a relaxed learning atmosphere, 73.8% of the students agreed that SCL provided a relaxed atmosphere compared with 60% for FLL. The difference between these outcomes was insignificant.

Students were also asked if they questioned the accuracy of information being discussed. During the FLL session, 83.1%

of the students did not question the accuracy of the information while only 10.8% did, yielding a statistically significant difference. However, 55.4% of the students did question the accuracy of the information being discussed during the SCL session, compared with 30.8% who did not.

Learning Skills

When asked which session provided them with an opportunity to enhance their ability to communicate with peers, a statistically significant difference was observed ($p = 0.006$) with 72.3% agreeing that SCL session helped achieve that goal compared with 36.9% for FLL session (Fig. 1). More students (43.07%) disagreed that the FLL session provided an environment where they can enhance communication with their peers. Throughout the SCL sessions, 52.3% of the students felt that this type of learning was associated with more accountability compared with 44.6% who had that feeling during the FLL session and the difference was statistically insignificant ($p = 0.5287$).

The majority of the participating medical students (61.5%) agreed that they were able to improve their independent learning skills during the SCL sessions, with only 13.9% who disagreed. Meanwhile, only 36.9% of students agreed that FLL sessions helped them develop those skills, showing a statistically significant difference ($p = 0.045$) between FLL and SCL sessions.

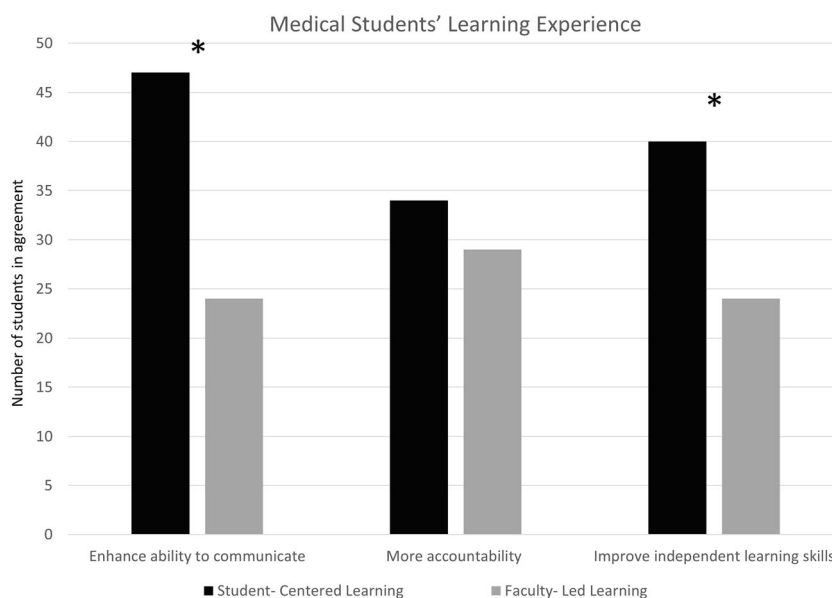
Anatomy Learning

When it comes to cognitive learning of anatomy, students were asked if each session was helpful in consolidating knowledge and 73.8% agreed that the FLL session helped in achieving that goal while 60% agreed that SCL session did, yielding a statistically insignificant difference ($p = 0.335$). From the participating students, 70.8% agreed that they were able to develop an in-depth understanding of the covered topic after the FLL session. The difference between the students’ ability to develop an in-depth understanding during the FLL compared with SCL session was also statistically insignificant with $p = 0.0665$.

Table 1 The number of medical students agreeing, disagreeing, and neither agreeing nor disagreeing to statements in relation to student-centered learning (SCL) and faculty-led learning (FLL) teaching sessions in the anatomy laboratory

	Disagree		Neutral		Agree	
	SCL	FLL	SCL	FLL	SCL	FLL
Engage throughout the session	10	11	8	10	46	43
Ability to concentrate (stay focused)	6	10	11	21	48	33
Stressful learning atmosphere	46	46	8	10	11	9
Relaxed learning atmosphere	8	11	9	15	48	39
Questioned the accuracy of information	20	54	9	4	36	7

Fig. 1 The number of students agreeing to different statements in relation to student-centered learning and faculty-led learning teaching sessions in the anatomy laboratory. Asterisk denotes statistically significant results



Most of the participating students (81.5%) felt that they were able to ask questions regarding challenging topics during the FLL session while 55.38% were able to do the same during the SCL session. Therefore, the difference between the two learning methods was insignificant. Meanwhile, at the end of the session, 69.2% of the students were able to remember the new anatomical terminology relevant to the topic compared with 50.8% after the SCL session. The difference between the 2 sessions was statistically insignificant ($p = 0.174$).

Advantages vs. Disadvantages

Students were asked to list some advantages and disadvantages of their experiences in both SCL and FLL sessions. They were also provided with an opportunity to provide feedback on how to improve both sessions. While Table 1 lists the advantages, disadvantages, and recommendations for the SCL session after completing a thematic analysis, below are some statements made in relation to this session.

Advantages of SCL are follows:

- “Nice to go through material on our own.”
- “More interactions among peers.”
- “More accountability and pressure to come prepared.”

Disadvantages of SCL are follows:

- “Some students take charge and elbow others out.”
- “Can’t ask questions sometimes incorrect assumptions.”
- “Students can teach each other incorrect information and can cause confusion.”

Table 2 lists the advantages, disadvantages, and recommendations for the FLL session after completing a thematic analysis and below are some statements made in relation to this session.

Advantages of FLL are follows:

- “Good explanation, tested on what we have learned.”
- “Information given is accurate and given in a logical sequence.”
- “Confidence in the knowledge been learned is correct.”

Disadvantages of FLL are follows:

- “Not always enough time to look at dissections on our own afterwards.”
- “Miss parts due to speaker speaking at low volume.”
- “Not enough time, usually the leaders teach quickly and I am unable to concentrate – just need more time to go through things slower.”

Table 2 Data showing the most common themes related to advantages, disadvantages, and suggestions to improve the SCL and FLL sessions

	SCL themes (n)	FLL themes (n)
Advantages	Engaging (11)	Faculty knowledge (13)
Disadvantage	Accuracy of information (29)	Inability to hear (16)
Recommendation	More time (15)	Smaller groups (12)

Discussion

Opportunities

The findings of this study show that medical student rated the SCL session highly for developing independent learning skills (61.5%), staying engaged (71.9%), relaxed learning atmosphere (73.8%), and enhanced communication (72.3%) and for their ability to stay focused (73.8%). Some of these factors are probably inter-related in which the students found the SCL sessions more engaging because they were interacting in a relaxed atmosphere and hence were able to improve their communication skills. The findings of this study corroborate those by Krych et al. [15] where they indicated that peer teaching not only led to improvement in understanding of the course material but also helped students in the development of communication skills, teamwork, leadership, confidence, and respect for peers which were all crucial factors in the development of professionalism. While this is not directly related to the anatomy learning outcomes, this learning space is providing medical students with an opportunity to develop their communication skills which is invaluable for their careers as physicians [22]. Moreover, students were able to improve on their independent learning skills, which is extremely important as a lifetime learner.

Medical students who took part in this study felt that they experienced a relaxed learning atmosphere during the SCL session. Another study indicated that students during peer teaching sessions felt at ease talking to their colleagues and also expressed confidence in asking questions [23]. Knowing that learning under stress can impact memory formation and hence lead to a negative learning experience, it is important that students during SCL sessions are able to benefit from a relaxed learning atmosphere [24]. Several factors such as readiness and prior knowledge impact the students' learning experience during an SCL session. When further analyzing the students' background, there was no difference between the choices of students with a science ($n = 46$) and those with a non-science background ($n = 15$).

Challenges

During SCL sessions, 55.4% of the participating students questioned the accuracy of the information while only 10.8% questioned the information during the FLL session. This was also reiterated by the students in the feedback section as one student said: "I can't ask questions sometimes incorrect assumptions" and another student stated: "students can teach each other incorrect information." A study by Chen et al. mentioned that communication between leaders and participants in peer teaching was crucial for improving awareness of a learner's abilities and team success [25]. Moreover, questions could be raised on whether truly there is a high risk of learning

wrong information during SCL sessions or that students are not confident in what they know. Studies have also demonstrated that students prefer to be taught by an instructor rather than being part of a student-centered activity [26]. This could also explain the general skeptical attitude of some students as they question the accuracy of the information being taught.

Another impact of the students' lack of self-confidence is their perception of learning throughout the SCL session. Only 46.1% of the participating students indicated that they were able to develop an in-depth understanding of the covered topic after the SCL session. Similarly, a smaller percentage of students considered that they were able to ask questions regarding challenging topics and that they were able to consolidate knowledge or remember new anatomical terminology after the SCL session compared with the FLL session.

Integration

In this study, we do not aim to promote for self-directed learning as a substitute to faculty-led learning in the context of our laboratory experience. On the contrary, we are trying to acknowledge the educational benefits of both models in helping the students achieve higher learning. Delivering a student-centered clinical tutorial using prosections is ideal to help the students grasp difficult concepts and guide them through the learning objectives in a timely manner [27]. As the students indicated, they are also able to ask difficult questions and benefit from the expertise of the faculty leading the session. Meanwhile, throughout the SCL session, students are able to spend some time trying to use critical thinking to identify structures and relate them to adjacent organs using textbooks, atlases, and other available resources. This type of interaction will help the students develop extremely important learning skills that they will use throughout their careers. Moreover, students will develop social skills on how to interact with their peers as they try to achieve a set of learning outcomes. Trying to integrate both models will help the students benefit from the advantages of both modalities. Ideally, students should be able to experience SCL and then followed by a FLL session to answer any questions or cover any material.

Several limitations restrict the findings of this study, one of which is student readiness. During this intervention, students did not receive any training on how to prepare for a SCL session. Moreover, the data was collected after one SCL session with no previous student exposure to this method. Another limitation is the lack of performance assessment after each teaching method. Students expressed their own perception of what they think they know, rather than exam results.

Conclusion

In conclusion, student-centered learning as a teaching tool could aid in student learning in the anatomy laboratory. This

teaching technique can complement in the delivery of the anatomical content while providing a relaxed learning environment. Moreover, students can benefit from developing important life skills such as communication and independent learning. Future studies should assess the impact of this type of learning on students' performance.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institution and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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