Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Anatomy

To Assess the Effectiveness of Chart-Based Learning in Anatomy for Phase -I MBBS Students

Soniya B. Parchake, MD[1], Praveen Singh, M.S[2], Minal Patel MSc PhD[3], Rajratna Ramteke[4], Md Nilesh. K Tumram, MD[5*]

[1]Associate Professor, Department of Anatomy, Government Medical College, Nandurbar, Maharashtra, India
[2]Professor, Department of Anatomy, Pramukh swami Medical College, Karamsad Gujrat India
[3]Professor, Department of Physiology Pramukh swami Medical College, Karamsad Gujrat, India
[4]Associate Professor, Department of Physiology, Government Medical College, Nandurbar, Maharashtra, India
[5]Professor and Head, Department of Forensic medicine and Toxicology, Government Medical College, Nandurbar, Maharashtra, India

DOI: https://doi.org/10.36347/sjams.2025.v13i05.034 | **Received:** 13.04.2025 | **Accepted:** 21.05.2025 | **Published:** 24.05.2025

***Corresponding author:** Md Nilesh. K Tumram
Professor and Head, Department of Forensic medicine and Toxicology, Government Medical College, Nandurbar, Maharashtra, India

Abstract **Original Research Article**

Background: The field of medical education is evolving to foster self-directed learning, critical thinking, and problem-solving skills. Anatomy, being a cornerstone of medical education, often presents challenges to first-year MBBS students due to its complex and intricate nature. Traditional didactic teaching methods are sometimes inadequate for effectively conveying such detailed content. Chart-based learning, utilizing visual tools such as tables, graphs, and diagrams, is emerging as an innovative teaching strategy aimed at simplifying complex information and improving student engagement and retention. ***Aim:*** To assess the effectiveness of chart-based learning in enhancing the understanding, retention, and conceptual clarity of anatomy for first-year MBBS students. ***Objectives:*** To assess the effectiveness of chart-based learning in anatomy through pre- and post-test scores. To evaluate student perceptions of chart-based learning through feedback. ***Methodology:*** This quasi-experimental study involved a convenient sample of 100 first-year MBBS students from the Department of Anatomy at Government Medical College, Nandurbar. Participants were randomly divided into two groups: Group A (experimental group) received chart-based learning, while Group B (control group) underwent traditional didactic lectures. Data was collected through pre- and post-tests, as well as a validated semi-structured feedback questionnaire administered online. Statistical analysis was performed using SPSS version 26 and Microsoft Excel 2019, with a significance level set at $p < 0.05$. ***Results:*** The comparison of post-test scores revealed that the chart-based learning group achieved consistently higher scores across various anatomy topics (e.g., Femoral Triangle, Hip Joint, Knee Joint, Arches of the Foot) compared to the didactic group. Statistical analysis indicated significant improvements in both groups from pre-test to post-test ($p < 0.05$), with the chart-based group showing greater learning gains. Student feedback indicated strong support for chart-based learning, with the majority finding it effective in clarifying complex concepts, enhancing visualization and memory, and fostering active participation and peer collaboration. ***Discussion:*** The study underscores the positive impact of chart-based learning on anatomy education. Visual tools, including charts, facilitated better understanding and retention of anatomical concepts and promoted active learning and collaboration among students. These findings align with previous research highlighting the advantages of visual aids in education. The study also emphasizes the importance of integrating modern teaching methods with traditional ones to improve learning outcomes. Additionally, the adaptability of chart-based learning across different educational levels and its effectiveness for diverse learners further support its integration into the curriculum. ***Conclusion:*** Chart-based learning proves to be an effective teaching strategy for enhancing the understanding, retention, and application of anatomical knowledge in first-year MBBS students. This method not only aids individual learning but also fosters collaborative learning. Integrating visual tools like charts into traditional teaching methods can significantly improve learning outcomes in medical education. Future studies could explore the integration of emerging technologies such as virtual and augmented reality to further enhance the effectiveness of chart-based learning.

Keywords: Chart-based learning, Anatomy education, Medical education, Active learning, Student perceptions, First-year MBBS students.

INTRODUCTION

The field of medical education is undergoing significant transformation, with a pronounced shift towards fostering self-directed learning, critical thinking, and problem-solving skills [1]. These changes reflect the broader educational goal of reducing reliance on passive learning and equipping future healthcare professionals with the skills necessary to navigate the complexities of modern medical practice. To achieve these objectives, educators are exploring and implementing innovative teaching methods that go beyond didactic lectures and rote memorization.

One of the most crucial subjects in the medical curriculum is anatomy, which serves as the foundation for all clinical knowledge and practice [2]. Understanding human anatomy is essential for medical students as it provides the anatomical basis for diagnosing and treating patients. However, for first-year MBBS students, anatomy often presents a significant challenge due to its vast scope and intricate details. Didactic teaching methods, such as lectures, small group learning (SGL), direct observation of procedural skills (DOAP), and demonstrations, though essential, sometimes fall short in making complex anatomical concepts easily understandable and memorable.

Given these challenges, there is a growing need to explore alternative teaching strategies that can enhance the learning experience and outcomes for students. One such strategy is the use of chart-based learning, which involves the creation and utilization of charts in the form of tables, graphs, and diagrams. These visual tools can simplify complex information, making it more digestible and easier to recall. By breaking down intricate anatomical structures into visual representations, charts can help students visualize and understand relationships between different parts of the body more effectively.

This study seeks to investigate the effectiveness of chart-based learning in the anatomy curriculum for phase 1 MBBS students. The rationale behind this approach is that charts not only facilitate better understanding but also encourage active participation from students. Furthermore, chart-based learning promotes peer teaching, as students can share and discuss their visual interpretations with classmates, leading to a deeper collective understanding of the subject matter.

The potential benefits of chart-based learning align with the overarching goals of modern medical education, which aims to produce medical graduates who are not only knowledgeable but also capable of applying their knowledge in practical, real-world settings. By providing a strong foundation in anatomy through innovative teaching methods, we can contribute to the development of competent Indian Medical Graduates (IMGs) who are equipped to meet the demands of healthcare [9].

This research will explore the impact of chart-based learning on students' ability to comprehend, retain, and apply anatomical knowledge, thereby providing insights into its effectiveness as a teaching tool in the early stages of medical education.

Aim & Objectives:

Aim: to assess the effectiveness of chart-based learning in improving the understanding, retention of knowledge and conceptional clarity of Anatomy in Phase 1 MBBS students.

Objectives:

1. To Assess the Effectiveness of Chart-Based Learning in Anatomy
2. To Evaluate Student Perceptions Toward Chart-Based Learning

METHODOLOGY

Study Design: A quasi-experimental design.

Status of Ethical Permission from the Institute: Ethical permission has been approved.

Sample Size and Selection

A convenient sample size of 100 first-year MBBS students from the Department of Anatomy at Government Medical College, Nandurbar, was selected for this study. All students enrolled in the first-year anatomy course were invited to participate, ensuring comprehensive coverage of the target population.

Inclusion & Exclusion Criteria:

Inclusion Criteria: First-year MBBS students who provided consent for participation.

Exclusion Criteria

First-year MBBS students who were absent or did not provide consent for participation. Ethical approval was obtained before starting the research. Written informed consent was collected in accordance with the guidelines using Google Forms.

Pre-Test and Post test Design

The pre-test consisted of 20 MCQs prepared by senior faculty members. The test was piloted on 20 students, and necessary corrections were made. The same set of questions was used for the post-test. Feedback forms were pre-validated by senior faculty, tested on 20 senior students, and revised needed.


Study group

The 100 participants were randomly divided into two groups of 50 each

Group A (Experimental Group):

Written informed consent was obtained before the study. This group underwent chart-based learning. The process began with obtaining informed consent and administering a pre-validated pre-test to assess baseline knowledge of anatomy. During the didactic lecture, students engaged in chart-based learning on the Femoral Triangle. Charts derived from recommended textbooks were used. After the chart-based learning session, pre-validated feedback was collected, and a post-test was administered to evaluate the effectiveness of this learning method.

Group B (Control Group):

This group served as the control and received didactic lectures on the Femoral Triangle without any additional chart-based learning. Informed consent and a pre-test were conducted initially. After the lecture, students provided feedback, and a post-test was administered to assess their learning outcomes. After a set period, the groups were interchanged for a cross-over comparison with the next topic (Hip Joint), followed by subsequent topics (Knee Joint and Arches of the Foot).

Data collection method: Tools/Instruments:

A validated, semi-structured questionnaire was used to collect data from participants. This questionnaire assessed the perceived benefits of chart-based learning using a Likert scale (5 = Strongly Agree, 4 = Agree, 3 = Unsure, 2 = Disagree, 1 = Strongly Disagree).

The questionnaire covered various aspects of the learning experience, including teamwork, concept clarity, and self-reliance.

Data Collection Methods

Data were collected after the completion of the chart-based learning sessions. Participants who consented to the study provided their feedback through an online survey conducted via Google Forms.

The survey link was distributed through a WhatsApp group created specifically for the study participants. To ensure completeness of responses, the Google Forms feature to prevent submission of partially filled questionnaires was enabled, making it mandatory for participants to complete the entire survey.

Process of Validation

As per the guidelines, written informed consent was obtained using a Google Form.

The pre-test consisted of 20 MCQs, prepared by senior faculty members. These questions were tested on 20 students, and necessary corrections were made based on their feedback. The same set of questions was used for the post-test as well. The feedback form underwent pre-validation by senior faculty and was tested on 20 students from a senior batch. Necessary corrections were made to ensure clarity and relevance. A validated, semi-structured questionnaire was used to collect data from participants.

Statistical analysis

The data from pre-tests, post-tests, and student perceptions of chart-based learning were compiled and analyzed using Microsoft Excel 2019 and SPSS version 26. Descriptive statistical measures, such as percentages, means, and standard deviations, were employed to summarize the data. The results will be presented in the form of tables and graphs, where relevant. A p-value of less than 0.05 was considered statistically significant, indicating the reliability of the observed differences in the study outcomes.

This version provides a clear and detailed outline of your study's aims, objectives, and methodology, emphasizing the systematic approach taken to evaluate the effectiveness of chart-based learning in anatomy.

RESULTS

Table 1: Comparison of Post test score in chart based and Didactic class group

Sr no	Topic	Chart based (n)	Didactic (n)	Post test chart based (mean ±SD)	Post test Didactic (mean±SD)	P value
1	Femoral triangle	41	49	13.01±3.12	11.34±3.6	<0.05
2	Hip Joint	49	49	16.83±4.38	9.02±3.88	<0.05
3	Knee joint	43	37	14.13±4.23	10.19±3.2	<0.05
4	Arches of foot	44	41	10.74±2.55	8.58±1.88	<0.05

Table 1 shows Comparison of Post test score in chart based and Didactic class group. For the Femoral Triangle, the chart-based group had a mean score of 13.01 compared to 11.01 for the didactic group. The Hip Joint topic showed the most substantial difference, with a chart-based score of 16.83 versus 9.02 for the didactic group. In the Knee Joint, the chart-based mean score was 14.13, higher than the didactic score of 9.91. For the Arches of the Foot, the chart-based group achieved a mean score of 10.50, while the didactic group scored 8.58.

Table 2: Comparison of Pre and Post test score

Sr no	Topic	Group	Pre-test chart based (mean ±SD)	Post-test chart based (mean ±SD)	P value
1	Femoral triangle	Chart based	5.13±2.47	13.01±3.12	<0.05
		Didactic	4.73±3.21	11.34±3.67	<0.05
2	Hip Joint	Chart based	2.59±2.32	16.83±4.38	<0.05
		Didactic	5.18±3.0	9.02±3.88	<0.05
	Knee joint	Chart based	3.53±2.16	14.13±4.23	<0.05
		Didactic	4.66±2.35	10.19±3.27	<0.05
4	Arches of foot	Chart based	3.46±2.7	10.74±2.55	<0.05
		Didactic	4.78±2.32	8.58±1.88	<0.05

Table 2 shows Comparison of Pre-Test and Post-Test Scores. This table compares pre-test and post-test scores (mean ± standard deviation) for students taught through chart-based learning and didactic teaching methods across four anatomy topics. It highlights the effectiveness of each teaching approach, with statistical significance indicated by the p-value (<0.05). Higher Learning Gains with Chart-Based Learning: Across all topics, students in the chart-based group consistently achieved higher post-test scores than those in the didactic group. Significant Improvement: Both methods demonstrated statistically significant improvement ($p < 0.05$) from pre-test to post-test. Initial Score Differences In some topics (e.g., Hip Joint), the chart-based group had lower initial scores but displayed remarkable improvement post-test.

Table 3: Feedback on chart-based learning as a teaching method in anatomy

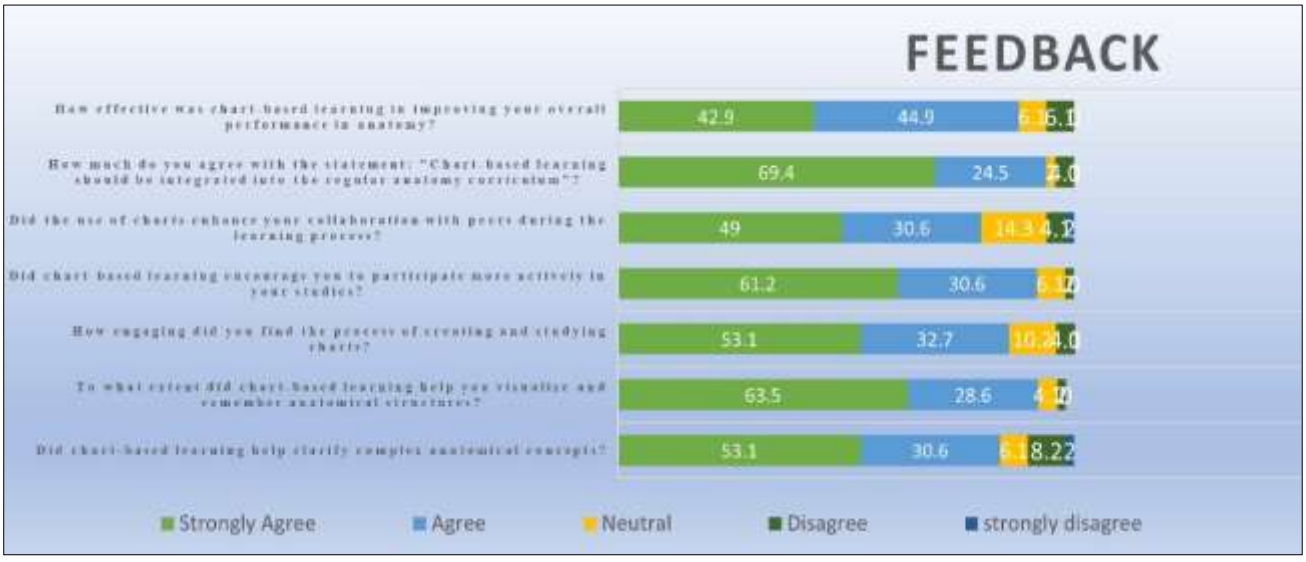
Feedback	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
	1	2	3	4	5
Did chart-based learning help clarify complex anatomical concepts?	53.1	30.6	6.1	8.2	2
To what extent did chart-based learning help you visualize and remember anatomical structures?	63.5	28.6	4.1	2	0
How engaging did you find the process of creating and studying charts?	53.1	32.7	10.2	4.1	0
Did chart-based learning encourage you to participate more actively in your studies?	61.2	30.6	6.1	2	0
Did the use of charts enhance your collaboration with peers during the learning process?	49	30.6	14.3	4.1	2
How much do you agree with the statement: "Chart-based learning should be integrated into the regular anatomy curriculum"?	69.4	24.5	2	4.1	0

Feedback	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
How effective was chart-based learning in improving your overall performance in anatomy?	42.9	44.9	6.1	6.1	0
What did you like most about chart-based learning?	Help me to remember Visualization of diagram and remembering easily Clarification Interactive study				
What challenges did you face while participating in chart-based learning?	Nothing majority of student Big size diagram Label should be large and bold				

Table no 3 and graph 1 shows Description of Feedback Table. This table summarizes student feedback on chart-based learning as a teaching method in anatomy. Feedback was collected using a Likert scale ranging from Strongly Agree (1) to Strongly Disagree (5) for various aspects of the learning experience. The percentages represent the distribution of responses for each question.

On whether chart-based learning help clarify complex anatomical concepts it was observed that Strongly Agree (53.1%) and Agree (30.6%) dominate the responses, showing that the majority of students found chart-based learning effective in clarifying complex concepts. Only a small percentage Disagree (8.2%) or Strongly Disagree (2%). In chart-based learning helping to visualize and remember anatomical structures, A significant majority Strongly Agree (63.5%) and Agree (28.6%) that charts enhanced visualization and memory. Very few were Neutral (4.1%), and minimal disagreement was recorded (2% Disagree, 0% Strongly Disagree). In question of How engaging the process of creating and studying charts, over half of the students Strongly Agree (53.1%) that the process was engaging, and 32.7% Agree. A small percentage remained Neutral (10.2%), with minimal disagreement (4.1% Disagree, 0% Strongly Disagree).

Most students Strongly Agree (61.2%) and Agree (30.6%) that this method increased their active participation. Only a small portion expressed Neutral (6.1%) or Disagree (2%) responses. Nearly half Strongly Agree (49%) and a third Agree (30.6%) that charts enhanced peer collaboration. Some students were Neutral (14.3%), with fewer Disagree (4.1%) and Strongly Disagree (2%) for this A strong majority Strongly Agree (69.4%) and Agree (24.5%), showing overwhelming support for integration into the curriculum with Minimal opposition (4.1% Disagree, 0% Strongly Disagree). On effectiveness of chart-based learning in improving your overall performance in anatomy, A balanced response with Strongly Agree (42.9%) and Agree (44.9%) forming the majority. Few students were Neutral (6.1%), and minimal disagreement (6.1% Disagree, 0% Strongly Disagree)



DISCUSSION AND CONCLUSION

The present study collectively underscores the effectiveness of chart-based learning and other visual aids across diverse educational contexts.

Enhancing Understanding and Retention: Anil D (2023) [3] highlighted the positive impact of self-directed learning (SDL), with tools like pie charts and graphs helping students better understand and retain concepts (Similarly, Patria *et al.*, (2020) [4] and Rafiu

Ademola Olatoye (2017) [1] found that visual aids, such as wall charts and real specimens, significantly enhanced vocabulary mastery and conceptual understanding in students. Alhamdani FY (2017) [5] supported these findings by emphasizing that anatomical drawings help students grasp complex anatomical relationships, reflecting the value of visual learning in anatomy education. While SDL tools foster self-motivation, chart-based methods provide structured guidance, indicating that a combination of these strategies could be highly effective in anatomy education.

Visual Aids vs. Traditional Methods: Rafiu Ademola Olatoye (2017) [1] demonstrated that charts, real specimens, and videos were superior to traditional teaching methods. This aligns with Dr. Sushan D (2007) [6], who showed that chart-based, case-based learning improved clinical knowledge in medical students. Chanakit (2012) [7] added that computer-aided learning (CAL) can complement traditional lectures by making concepts more accessible and promoting self-study. These findings collectively indicate that while traditional teaching has its place, integrating modern and interactive methods such as charts and CAL tools significantly enhances learning outcomes.

Facilitating Active Learning and Collaboration: Shashi Sharma (2013) [2] emphasized the importance of collaborative efforts among educators to develop students' critical graphing skills, resonating with Lisa J. Staton (2007) [8], who advocated peer chart audits to foster practice-based learning and teamwork. Judy L. Paukert (2003) [9] reinforced this by showing how peer-based review methods enhance preventive care skills among residents. These studies suggest that chart-based learning not only facilitates individual understanding but also encourages active collaboration, a critical skill in medical education and practice.

Adaptability Across Contexts: The studies by Ethan F. Kuperman (2014) [10] and Palonen (2006) [11] on chart audits demonstrate the adaptability of visual methods for evaluating performance and guideline compliance, even in clinical training settings. Patria *et al.,* (2020) [4] and Rafiu Ademola Olatoye (2017) [4] extend this adaptability to secondary education, showing that visual tools are universally beneficial.

This adaptability highlights the scalability of chart-based methods across educational levels, from school students to medical residents.

Effectiveness for Diverse Learners: The review consistently demonstrates that visual aids are particularly effective for learners with lower initial scores, as seen in Dr. Sushan D [6] and Anil D (2023) [3]. The focus on improving baseline knowledge through visual tools is critical for bridging gaps in diverse learning groups.

CONCLUSION

The study provides compelling evidence that chart-based and other visual learning methods enhance understanding, retention, and performance across educational settings. Their adaptability, efficacy for diverse learners, and ability to promote active collaboration make them indispensable tools in modern education. However, integrating these methods into traditional curricula requires careful planning and collaboration among educators to ensure a balanced and inclusive learning environment. Future research could explore combining chart-based learning with emerging technologies, such as virtual and augmented reality, to further enhance learning outcomes.

REFERENCES

1. Rafiu Ademola Olatoye (2017) [5]; Effect Of Teaching Using Charts, Real Specimens and Videos On Secondary School Students' Achievement In Mammalian Skeletal System Concepts; ISSN 2171-9098 · ENSAYOS. Revista de la Facultad de Educación de Albacete, Nº 32-2, 2017, (63-75)
2. Shashi sharma et al: Assessıng students' understandıng of tables and graphs: Implıcatıons for Teachıng and Research; Int. J. Eud. Res. Technol: Volume 4; December 2013: 51-70
3. Anil D, *et al.,*: Self-directed learning: The impact among medical students. J Med Educ Dev. 2023;16(50).
4. Patria, *et al.,* : The use of of wall charts as mediato teach vocabulary Journal of English Educational Study Volume 3 Issue 2 November 2020 Page 78-86 E-ISSN: 2655-077
5. Alhamdani FY, *et al.,*: Drawings as learning aid for the human anatomy students' based evaluation;. J Oral Health Craniofac Sci. 2017; 2:90-95
6. Sushan D, *et al.,*: Chart-based and case-based learning in medical education.J. Med. 2007.
7. Chanakit T *et al.,*: Computer-aided learning for medical chart review instructions; Afr J Pharm Pharmacol. 2012;6(27):2061-7.
8. Lisa J Staton *et al.,*: A Peer chart audits: A tool to meet Accreditation Council on Graduate Medical Education (ACGME) competency in practice-based learning and improvement. Implementation Science 2007, 2:24
9. Paukert *et al.,* (2003): Do peer chart audits improve residents' performance in providing preventive care academic medicine, vol.78.october supplement 2003
10. Ethan F. Kuperman et al: Comparing Resident Self-Report to Chart Audits for Quality Improvement Projects: Accurate Reflection or Cherry-Picking Journal of Graduate Medical Education, December 2014
11. Palonen *et al.,* Measuring resident physicians' performance of preventive care comparing chart review with patient survey J gen intern med 2006; 21:226–230

12. Hendricson WD *et al*.,: Future directions in dental school curriculum, teaching, and learning. 75th anniversary summit conference. ADEA, American Association of Dental Schools. 1998. Available from: https://goo.gl/7mj4aS

Feedback Questionnaire on ‘’The Effectiveness of Chart-Based Learning in Phase 1 MBBS Students"

Section 1:

1. Student Roll no: _____
2. Age: _____
3. Group Assignment:
   - Group A (Chart-Based Learning)
   - Group B (Control Group)

Section 2: Learning Experience

5. How would you rate your understanding of anatomy before participating in this study?
   - Very Poor
   - Poor
   - Average
   - Good
   - Excellent
6. How would you rate your understanding of anatomy after participating in chart-based learning?
   - Very Poor
   - Poor
   - Average
   - Good
   - Excellent
7. Did chart-based learning help clarify complex anatomical concepts?
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
8. To what extent did chart-based learning help you visualize and remember anatomical structures?
   - Greatly
   - Moderately
   - Slightly
   - Not at all

Section 3: Engagement and Participation

9. How engaging did you find the process of creating and studying charts?
   - Very Engaging
   - Somewhat Engaging
   - Neutral
   - Not Very Engaging
   - Not Engaging at All
10. Did chart-based learning encourage you to participate more actively in your studies?
    - Strongly Agree
    - Agree
    - Neutral
    - Disagree
    - Strongly Disagree
11. Did the use of charts enhance your collaboration with peers during the learning process?
    - Strongly Agree
    - Agree
    - Neutral
    - Disagree
    - Strongly Disagree

12. How much do you agree with the statement: "Chart-based learning should be integrated into the regular anatomy curriculum"?
    - Strongly Agree
    - Agree
    - Neutral
    - Disagree
    - Strongly Disagree

Section 4: Effectiveness and Outcomes

13. How effective was chart-based learning in improving your overall performance in anatomy?
    - Very Effective
    - Effective
    - Neutral
    - Ineffective
    - Very Ineffective
14. **Did chart-based learning help you in the following areas?** (Please rate each statement)

- Clarifying anatomical relationships:
  - Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree
- Enhancing long-term retention of anatomical knowledge:
  - Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree
- Improving confidence in applying anatomical knowledge:
  - Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree
- Developing problem-solving skills related to anatomy:
  - Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree

Section 5: Open-Ended Questions

15. What did you like most about chart-based learning?
    Response: _____
16. What challenges did you face while participating in chart-based learning?
    Response: _____
17. Do you have any suggestions for improving chart-based learning in anatomy?
    Response: _____
18. Any additional comments or feedback?
    Response: _____