

Riding The Wave of Technology Integration by Applying Student-Centered, Blended Learning Course Design Principles in a Human Anatomy Course

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Abstract: This case-study focuses on improving the teaching and learning experience of second year students in a Human Anatomy course at a Health Sciences University in South Africa. The students were underperforming, and the repeaters caused classes to become overcrowded. In search of a solution an instructor of the course and an instructional designer at the University worked on a re-design of the course by including technology and increasing interaction with the course content and peer collaboration as supported by research and best practices. A mixed-methods research methodology was utilized by collecting qualitative and quantitative data. The qualitative data was collected from an interview with the lecturer and a feedback survey from the students. For the analysis of the qualitative data a thematic analysis was applied to identify themes and subthemes which were sorted under the following sub-questions: what were the challenges, successes and suggestions of the newly designed course? Additionally, quantitative data was collected from the students' grades. The application of technology and increased student engagement proved to be successful, and the study proposes a framework based on best practices and feedback from the lecturer and students for an improved course design for the future.

Keywords: Case-study, Student performance, Course design, Mixed method, Thematic analysis, Instructional design, Teaching and learning experience, Collaborative learning, Gamification and student-centered learning

1. Introduction

During a time where waves of new technologies are flooding the market, educators are often overwhelmed and rather reluctant to “ride the wave”. It may however be a time when these new technologies could be used to offer opportunities to lecturers and students to change their traditional ways of teaching and learning by incorporating student-centered course designs and pedagogies, - These changes could ultimately improve students' interest and performance (Garcia, 2000; Koehler, et.al.,2004; Baldwin, S., Ching, Y. H., and Hsu, Y. C. 2018).

The concerning performance of students in a second year Human Anatomy course at a University of Health Sciences in South Africa the instructor of the class and the instructional designer at the University explored best practices for redesigning the Human Anatomy course. The design focused on moving from traditional lecturer centered behaviorist teaching approach to a student-centered blended learning approach based on best practices. These were based on the ADDIE Instructional designer model and the first principles of Merrill (2021). These best practices were used to review the “old” course, and an interactive learning experience was designed, developed, implemented and evaluated. (Figure 1)

2. The Objective of the Study

The aim of this study was to improve the performance of students by changing a traditional lecturer centered course to a student centered interactive, blended learning experience. After the course was redesigned and implemented, the feedback of lecturers and students will be used to compile a framework for future updated course designs.

3. Problem Statement

The problem statement of the study positions that: “Student performance in an identified undergraduate Human Anatomy course needs improvement”. This statement leads to the research question: “How can courses be designed to improve student performance in a Human Anatomy course?” To further the investigation the following sub-research questions were included in the interview: “What were the challenges of the old class?”

“What in your opinion were the successes of the re-designed class”? and “What suggestions do you have for future course-designs for your class?”

4. Background and Literature Review

According to (Brown and Katz; 2011), one should prioritize design in all fields of life by inviting designers to boardrooms and financial meetings, and to “rather enlist designers, to make an already developed idea more attractive”. From the instructional design perspective, one needs to apply best practices to achieve the best results (National Research Council [NRC] 2004).

Various theorists in this field state that the design process is a multileveled, collaborative, iterative and theory driven process. (Brown, 1992; Collins, 1999). They argue that theory needs to be tested in a real-world setting which includes schools or universities, districts and communities. By applying the action research: “design-analysis-re-design” iterative research approach, improvements can be made on all levels of a course.

For this study the instructor of the course and the instructional designer collaborated on designing a student-centered approach by adding activities such as 1. Video recorded assignments, 2. Pre-and post quizzes (Mazur, 2013). 3. Applying a flipped classroom approach (Tucker, 2012) as well as implementing 4. Gamification principles (Groh, 2012). These activities increased the student engagement with the content and were respectively introduced into the courses per term. The design of the lessons was based on Merrill’s design of instruction (2012) and on the ADDIE instructional design models.

5. Research Methodology

A mixed methods action research methodology was followed for this case study. An action research methodology was selected as the research took on a cyclical iterative process (Figure 1). It refers to a research approach where a change is expected. A cyclical, iterative approach contributes to the improvement of existing practices (O’Leary, 2007).

The instruments for collecting the qualitative data included an interview with the lecturer about her experiences with the new interactive course design and a feedback survey from the students.

At the end of each block (section) the students wrote a test, and the results were recorded in the grade center of the LMS. These grades incorporated the quantitative data of the study.

Both sets of qualitative data were used to identify challenges, successes and suggestions. Additionally, the quantitative data were validated by comparing the grades of the 2022 and 2023 cohorts. The three sets of data were triangulated to support the findings.

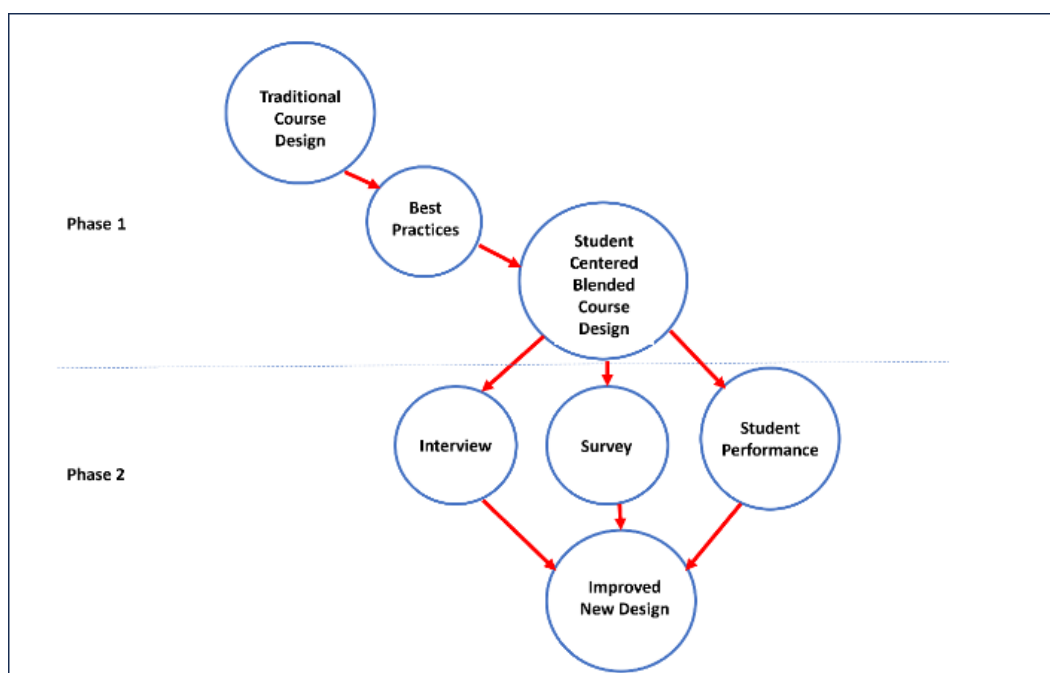


Figure 1: Course design phases

In this study, iterative action research was implemented over two phases. Phase 1, refers to redesign of the “old traditional course” based on best practices. In Phase 2, a student-centered course structure is designed and implemented over a year (referred to as “new” design). Thereafter, the lecturer reviews the old and new designs during an interview with the researcher. Additionally, the student survey provides the researcher with their opinion about on the new course design. The performance of the student from the “old course” and the “new course” are compared to find their opinions on the “old” and “new” course designs. These data sets provide valuable input for designing an improved course.

Phase 1 - Description of the old course

The course was built on the LMS of the University by the lecturer. Before the re-design of the old course the lecturer used the LMS for loading the course content and some quizzes without a specific structure.

The lecturer loaded resources such as PowerPoint slides and Lecture Notes for students to read after classes and summative assessments in the form of quizzes for revision of learning material to the course. These documents and quizzes were loaded in folders without a specific structure.

The “old” course was not used as an active teaching and learning platform but rather as a repository for the content followed by formative quizzes for testing the students’ knowledge after a section. The lecturer followed a traditional lecturer-centered approach with limited student engagement.

The “old” course included two face-to-face lectures and one clinical practical session a week. The amount of information was enormous, and the lecturer followed a lecturer-centered approach to cover the load of content as fast as possible.

The timelines included the first phase (Fig 1) which was conducted at the end of 2022 when the old course was analysed.

The second phase (Fig 1) was done at the beginning of 2023 where additional activities were added based on Merrill’s Instructional design model.

After the changes were made and the course ran for a year in 2023, the lecturer and students were requested for their feedback. The feedback would assist the designer to improve the design based on action research principles where a study is repeated with improved iterations.

The “old” lecturer centered course, was analyzed based on the ADDIE instructional design model. Additionally, Merrill’s principles of first instruction (2012), were used to improve student’s engagement with the content. This model includes task centered, activation, demonstration, application and integration of new content (Merrill, 2012).

Phase 2 – New course design

In Phase 2, a student-centered course structure was designed and implemented over a year (referred to as “new” design). After considering best practices, the lecturer created learning modules which were divided into terms and in each learning module where all resources and activities for that term were included in respective folders.

After the changes were made the course ran for a year in 2023 and then the lecturer and students were requested for their feedback. The feedback would assist the designer to improve the design based on action research principles where a study is repeated with improved iterations.

The organization of the content was needed to improve navigation and to offer learning paths to accommodate learning preferences of students, with the student in mind.

Activities that were added to the new designed course, included:

- Term 1 -Video recordings by students on the upper thorax region as group work and uploaded in the discussion area of the Learner Management System,
- Term 2 - Students drawing and using clay to build muscles around the skeleton.
- Term 3 - Compiling question banks and quizzing each other.
- Term 4 - Lecturer compiling Quiz Questions with Kahoot;

The aim of the design focused on increased student engagement with the content.

5.1 Evaluation

After Phase 1 and 2 were implemented and then the re-designed “new” course was reviewed by the lecturer and the students based on the research questions of the study. These questions included the challenges, successes and suggestions of redesigning a Human Anatomy course to achieve a more student-centered approach and ultimately aiming at improving the student’s engagement, enthusiasm and performance.

5.2 Sampling and Population

The study utilized purposive sampling. This approach is relevant for classes with student participants that are readily available (Kandola; 2014). The sampling population for this study included the instructor and a class of 60 students.

5.3 Reliability and Validity

The reliability and validity of the data analysis lies in the analysis of the data by searching for specific themes and by member checking with a research participant (the instructor in this case) to ensure that the researcher understood the interview questions and answers them correctly (Harvey; 2015). The following steps were taken to ensure validity and reliability of the data. Step 1: Becoming familiar with the data, Step 2: Generating initial codes, Step 3: Searching for themes, Step 4: Reviewing themes, Step 5: Validate themes by a research participant. Step 6. Defining themes, Step 7: Write-up. (Braun and Clarke; 2012).

5.4 Data Collection, Analysis and Results

During the second phase in Fig.1, the first set of data was collected during a virtual interview with the lecturer. Thereupon the transcript of the recording was downloaded and analysed.

The second set of data collection was retrieved from a post-course survey from participating students. And the third set of data was collected from the students’ grades from the previous and the current courses which were retrieved from the learner management system. After the data collection the data was analysed as described below.

5.4.1 Data collection 1 – the interview

The data from the interview with the lecturer was analysed by applying an inductive thematic analysis (Williams; 2007). Where the data are read and scrutinized by searching for patterns in the data which are organized into themes. The researcher makes sense of the data from his/her perspectives by applying an active reflective process. The perspective is based on best practices in the field of instructional design (Braun and Clarke; 2021).

A “spreadsheet” software was used for data analysis. The identified themes were added to the spread sheet in verbatim. An inductive approach was followed. This is a flexible analysis approach which means that the researcher allows the data to guide the analysis. This approach is used to identify emerging patterns, themes and concepts (Williams; 2007). The researcher reflects on each theme in the context of the course. The themes were identified and compiled into Table 1.

5.4.2 Data collection 2 - survey

For the second data capture and analysis, the students were requested to give their feedback by completing a survey. After collecting the data an inductive thematic analysis was applied (Williams; 2007).

The survey questions were divided into challenges, successes and suggestions. The answers were sorted and analysed by using spread sheets again. Specific concepts were found under each theme. The themes and concepts are added to the last column of Appendix 1, (Table 3).

A thematic analysis was conducted to identify relevant themes in the lecturer’s and students’ feedback. By applying member checking the analysis and interpretation of the interview was validated by the research participant.

5.4.3 Data collection 3 - student grades

The third set of data was collected from the student performance during 2022 and 2023 (Table 1).

5.5 Data Analysis

The instruments for the data analysis include an interview, a survey and the performance of the students. All subjects gave their informed consent for inclusion before they participated in the study. The study was

conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of SMUREC (SMUREC/A/310/2023:IR).

5.5.1 Interview

The data from the interview with the lecturer was analysed by applying an inductive thematic analysis (Williams; 2007). Where the data are read and scrutinized by searching for patterns in the data which are organized into themes. The researcher makes sense of the data from his/her perspectives by applying an active reflective process. The perspective is based on best practices in the field of instructional design (Braun and Clarke; 2021).

A spreadsheet software was used for the data analysis. The identified themes were added to the spread sheet in verbatim. An inductive approach was followed. This is a flexible analysis approach which means that the researcher allows the data to guide the analysis. This approach is used to identify emerging patterns, themes and concepts (Williams; 2007). The researcher reflects on each theme in the context of the course. Themes were identified and presented in Table 3.

5.5.2 Student survey

For the second data capture and analysis, the students were requested to give their feedback by completing a survey. After collecting the data an inductive thematic analysis was applied (Williams; 2007).

The survey questions were divided into challenges, successes and suggestions. The themes and concepts were compiled in a table format and are added in the last column on Addendum 1. A thematic analysis was conducted to identify relevant themes in the lecturer's and students' feedback. By applying member checking the analysis and interpretation of the interview were validated by the research participant.

5.5.3 Student performance.

The third set of data was collected from the student performance of two cohorts. These included data from their final grade.

6. Bias and Limitations of the Study

The researcher may have been biased because her field of research is directly related to designing courses to improve student learning. This may influence her judgement as her positive approach may affect her search for positive factors that support her field of study. To reduce any bias, both the instructor and an external reader have critically reviewed the thematic analysis and conclusions.

7. Findings and Conclusion

The conclusion aims at answering the research questions which included the following: "What strategies can be implemented to improve student performance in a Human Anatomy course?"

The challenges, success and suggestions for the new course, as experienced by the participants, are presented in Table 2 with a more detailed explanation in Table 3 and 4.

Besides the importance of improved student engagement, the performance also indicates that the student grades improved. The previous cohort from 2022 indicated a high percentage of absenteeism and that students became too stressed and worried about the class, to enjoy it.

By adding best practices to phase 1 the updated course design improved. This was also supported by the improvement of the students' throughput rate. These results could be the breakthrough the relevant University had been hoping for because currently the high retention rate of the second year Human Anatomy cohort, is concerning as it blocks the students' progress at the university.

The comments from the interview and the surveys from the qualitative data are supported by the quantitative data. The grades indicate an increase of 10% on the class average compared to the class percentage of the previous cohort. Another astounding result is the decreased year's failure rate, from 30% to 16% (by 14%) as depicted in the Figures 2 and 3 below.

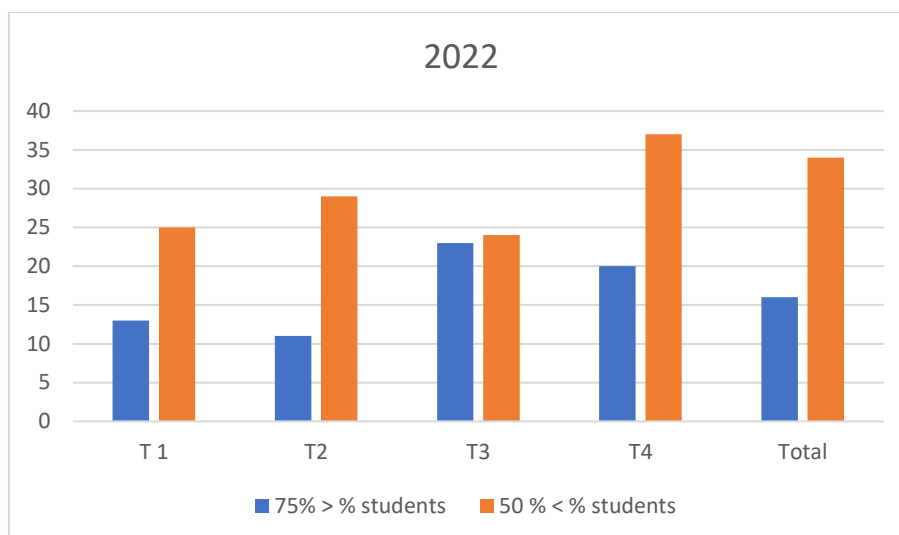


Figure 2: Student performance 2022

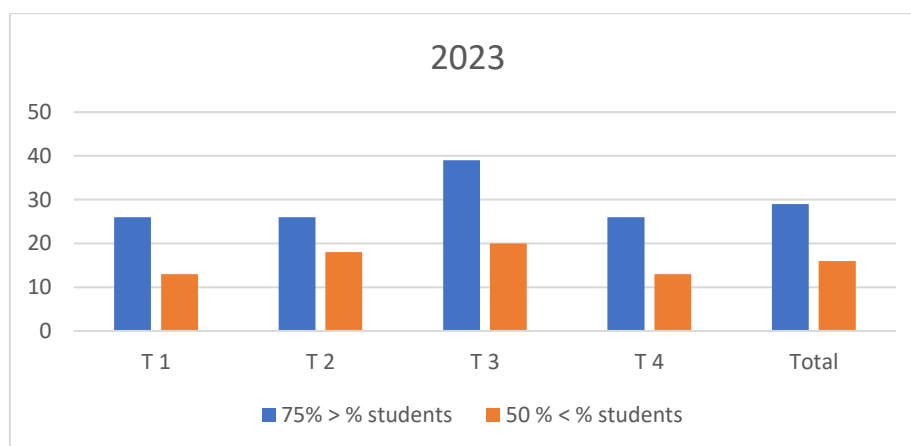


Figure 3: Student performance 2023

The most impressive result of the redesigned course was the increased student engagement with the course content and the high percentage of the students from the BB training class receiving distinctions. The distinction percentage increased from “16%” in the “old” course to “29%” in the “new” course, and thus the students achieved a class average of 75%, in the “new” course.

Besides the improved performance of the students the positive results were supported by the words of the lecturer who ended the interview with the comment: “and there were no troublemakers in the class this year”. This statement supports the importance of the positive involvement of the students. The results also indicate the remarkable change from being anxious about failing behind in the class to being motivated and to achieving success. From these results a strategic course design framework based on the results in Table 1 can be proposed for future use.

Table 1: Comparison of Student performance 2022 and 2023 per term and year

	2022	T 1	T 2	T 3	T 4	Total	2023	T 1	T 2	T 3	T 4	Total
Percentage of class achieving more than 75% (Distinctions)		13	11	23	20	16		26	26	39	26	29
Percentage of class achieving less than 50% (Failures)		25	29	24	37	34		13	18	20	13	16

In conclusion, this case-study contributed to encouraging the lecturer to successfully ride the technology wave by re-designing a course based on best practices. Thereby improving the students' performance and motivation and ultimately improving from a class where a third of the class were failing to a class with low failures and a third achieving distinctions is a mentionable achievement. Therefore, this case-study can be recommended for student centered blended learning courses designs in the future.

AI Statement: The authors state that Artificial Intelligence tools were not used in this study.

Ethics Statement: Ethical approvals have been obtained with precautions taken to ensure participants' informed consent and confidentiality.

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Appendix 1: Tables 2, 3 and 4

Table 2: Data collection – Interview and survey

Lecturer's perspective (Interview)		
Challenges of old design	Successes of new design	Suggestions for the next updated design
Quizzes of learning only Limited group participation Time management and work ethics Low level learning Low engagement with the content Low motivation Technology challenges Low take up of pre and post-tests Low group work participation Increased grading time Group activities took time	Quizzes for and of learning Increased group participation Enjoyment of Gamification, Increased time for practical sessions Increased student engagement Increased competition Increased collaboration Increased creativity	Adding grades to pre- and post-tests and to their total year marks. Improving active participation in group work. Adding rubrics to improve understanding of criteria and decrease grading time.
Students' perspective (Survey)		
Challenges of old design	Successes of new design	Suggestions for the next updated design
Complicated content High workload Challenge with time management Limited time to complete assignments Too fast teaching pace Low audibility in class Tutors can't always assist High Anxiety	Students' confidence grew. The course was well organized, Excellent lecturer Better understanding Better guidance Increased knowledge checks Improved knowledge retention Increased motivation	Access to previous tests More time to spend with specimens Lectures should be chunked and not too hurried. 10-minute breaks between 40-minute sessions No morning classes All demonstrators need to know their work Tests need to be spaced out over two weeks. More moderators are needed in group activities.

Table 3: Data Analysis

Feedback on courses before design changes	
Challenges from the lecturer perspective	Explanation
<ul style="list-style-type: none"> Limited revision Limited group participation Time management and work ethics 	<ul style="list-style-type: none"> Quizzes were only conducted as assessment of learning and not for learning. Not all students participated in group projects. The students were struggling with time management and work ethics including procrastinating, low completion of self-assessments, low activity in pre- and post-lecture quizzes, low preparedness of students). They were also struggling with understanding = the content and dealing with high workload

<ul style="list-style-type: none"> • Practical sessions 	<p>other by competing with quiz games such as Kahoot.</p> <ul style="list-style-type: none"> • “Practicals” were very helpful for learning and understanding the content. Apprehension to work with specimens became better with more practical work.
<p>Additional successes mentioned by the lecturer</p>	<p>Explanation</p>
<ul style="list-style-type: none"> • Increased student engagement- • Increased competition – • Increased collaboration - • Increased creativity- • Better understanding – • Better guidance – • Increased knowledge checks – • Improved knowledge retention - • • Using study guide for outcomes guidelines and for questions- • Improved rubric creation skills • Improved the course goal awareness - • Adding interactive VR visual tools (Primal pictures)- • Better time management – • • Increased engagement with content • Improved engagement with content with added activities. 	<ul style="list-style-type: none"> • Students became more engaged with the content. • Games challenged students to become more active. • Group activities contributed to students learning from each other. • Video recordings of dances to indicate muscle sections and using colour for learning diagrams stimulated the students' creative thinking • Demonstrating concepts and terminology to increase better understanding • Guiding students' activities with rubrics • • Adding pre- and post-test. • Students creating quiz questions for increased engagement with content. • Aligning the course design with the study guide outcomes • Reducing grading time with a good rubric • Encouraging students to use their study guide as a guideline from the beginning of the year. • • Improving student engagement with multi-media • Flexible assignments time for students to work from home • Variety to their usual classroom experience.
<p>Successes mentioned by students</p>	<p>Explanation</p>
<ul style="list-style-type: none"> • Their confidence grew. • The course was well organized • Excellent lecturer 	<ul style="list-style-type: none"> • By increased knowledge • They knew exactly what was going on. • She is very organized
<p>Suggestion from the lecturer for future course design includes the following points:</p>	<p>Explanation</p>
<ul style="list-style-type: none"> • Adding grades to pre- and post-tests and to their total year marks. • Improving active participation in group work. • Adding rubrics 	<ul style="list-style-type: none"> • It is crucial to add points to pre and post-tests for the class work as students do not consider taking tests without them counting towards their grades. • For inactive group members group leaders should only add the names of active participants to group work. • To cut down on grading time.
<p>Suggestions from students</p>	<p>Explanation</p>
<ul style="list-style-type: none"> • Access to previous tests • Need more time to spend with specimens 	<ul style="list-style-type: none"> • For preparation • More practical time is needed

<ul style="list-style-type: none"> Lectures should be chunked and not too hurried. 10-minute breaks between 40-minute sessions No morning classes All demonstrators need to know their work Tests need to be spaced out over two weeks. More tutors are needed in group activities. 	<ul style="list-style-type: none"> Lecturers should work slower in class They need Breaks during face-to-face classes. They prefer afternoon classes. All tutors should be present. Tests should be taken every two weeks. More support is needed during group activities.
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Table 4: Summary of Findings

Lecturer's perspective		
Challenges of old design	Successes of new design	Suggestions for the next updated design
<ul style="list-style-type: none"> Quizzes of learning only Limited group participation Time management and work ethics Low level learning Low engagement with the content Low motivation Technology challenges Low take up of pre and post-tests Low group work participation Increased grading time Group activities took time 	<ul style="list-style-type: none"> Quizzes for and of learning Increased group participation Enjoyment of Gamification, Increased time for practical sessions Increased student engagement Increased competition Increased collaboration Increased creativity 	<ul style="list-style-type: none"> Adding grades to pre- and post-tests and to their total year marks. Improving active participation in group work. Adding rubrics to improve understanding of criteria and decrease grading time.
Students' perspective		
Challenges of old design	Successes of new design	Suggestions for the next updated design
<ul style="list-style-type: none"> Complicated content High workload Challenge with time management Limited time to complete assignments Too fast teaching pace Low audibility in class Tutors can't always assist High Anxiety 	<ul style="list-style-type: none"> Students' confidence grew. The course was well organized, Excellent lecturer Better understanding Better guidance Increased knowledge checks Improved knowledge retention Increased motivation 	<ul style="list-style-type: none"> Access to previous tests More time to spend with specimens Lectures should be chunked and not too hurried. 10-minute breaks between 40-minute sessions No morning classes All demonstrators need to know their work Tests need to be spaced out over two weeks. More moderators are needed in group activities.