SECP 1513: Technology Information System

Semester 01, 2024/2025

PROJECT PROPOSAL

BioLabz SYSTEM

Team Name: Tech Wizards

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1. Introduction

A study published in the International Journal of Instruction highlights the effectiveness of Mobile Augmented Reality (MAR)-Assisted STEM-Based Learning, reporting significant improvements in students' average score compared to conventional learning methods[1]. The study categorizes MAR-assisted learning outcomes as "very well" and "good," emphasizing its ability to engage students actively in concept discovery through exploration activities using Augmented Reality (AR) media[1]. This demonstrates the potential of AR to transform STEM education by promoting active learning and improving comprehension of complex concepts. Similarly, students in the Faculty of Science, especially biotechnology will benefit greatly from an AR-based learning system. The system addresses the growing need for more accessible and cost-effective virtual lab experience for the biotechnology students. Biotechnology students might face challenges during their traditional, face-to-face lab experiments due to insufficient equipment and struggles in visualizing biological processes such as DNA replication and memorizing complex topics.

Our approach leverages cutting-edge technology to create a mobile-based AR system that simulates the real-world lab experience and enhances visualization with 3D models of complex biotechnology concepts. The system, called BioLabz, will be accessible from any Android or IOS devices, making it much more flexible and affordable as most students already have these devices. The core feature of BioLabz is its gamified learning system dedicated to covering all the biotechnology experiments and topics which will help students overcome challenges usually faced from a face-to-face lab experience This feature is also able to engage students in interactive simulations with 3D models of biotechnology processes such as cellular functions and DNA structures. BioLabz is a marker-based AR system where students scan QR codes in order to unlock specific topics or lessons. Once a code is scanned, the app generates detailed 3D models that students can manipulate, explore, and edit, providing a hands-on approach to learning. The app covers a wide range of topics in biotechnology from beginner, intermediate and advanced, allowing users to engage actively with material suited to their knowledge.

BioLabz offers numerous benefits for both students and educators, transforming the traditional learning experience into a more interactive and engaging one. For students, the app provides a safer environment to conduct virtual experiments, eliminating risks and constraints of physical lab setups that sometimes is insufficient. It covers a wide range of biotechnology topics and helps students to visualize complex concepts in a 3D format, enhancing their understanding. This approach encourages students to study more effectively and independently. Educators can also gain advantages from BioLabz. The app features a personalized structure where educators can access to tailor the difficulty of experiments to suit the needs and abilities of their students. This customization ensures that the learning process remains challenging yet accessible for all learners(Appendix B). By also integrating gamification, students are able to immerse themselves in the simulation experience where it increases students' motivation and makes the overall learning process enjoyable[2]. By combining safety, accessibility and interactivity with an engaging gamified element, BioLabz fosters an environment where students are motivated to explore, learn and excel in biotechnology.

Moving on to our competitors, Step Into Biology, is an application similar to ours where they are also an augmented reality (AR) application related to biology, however ours differ to theirs as they only cover they visualization part and do not cover the virtual lab unlike ours[3]. That being the case, this application lacks educational content and is not suitable for university students as it only covers the upper secondary level topics. Another competitor of ours, Merge EDU, an augmented reality (AR) application however theirs covers a wider range of topics which includes topics related to STEM and Science[4]. That being the case, they also cover upper secondary level topics only and their pricing can go up to $5999 dollars a year to access their application. With these flaws in these applications in mind, we developed our system to not have these flaws, to have a wider range of educational topics related to biology as well as being affordable for students. This would definitely give us an advantage over our competitors and make us stand out more in the market.
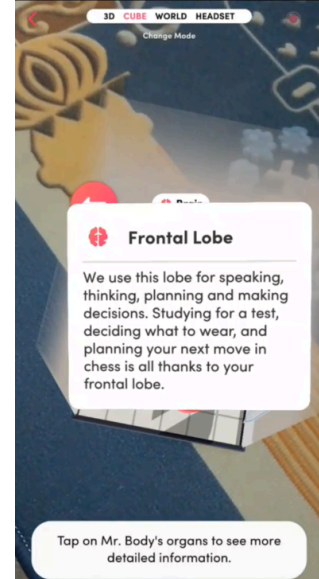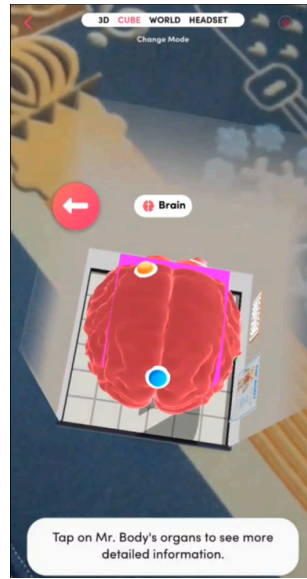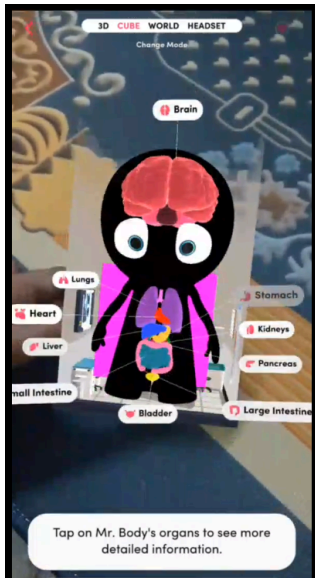
2. Existing Systems

According to the present laboratory systems, the majority of the labs are physical ones and although they deliver practical experience they do come with their own challenges including: being costly, lack of easy access as well as security issues that arise due to the use of dangerous materials and equipment. To address these issues, computerized systems like Step Into Biology and Merge EDU have emerged (Appendix A), offering virtual simulations for students which are our key competitors, both of which offer an AR-based educational app but have notable limitations that BioLabz aims to address. Step Into Biology is an AR app designed to make biology concepts engaging through immersive field trips. It offers a range of interactive experiences, including explorations of animal and plant cells, DNA replication, and offers free lesson plans to assist educators. While it is free for students and is available on both iOS and Android platforms, the app focuses solely on visualization of biological components and lacks a virtual lab feature. Additionally, this app is limited to upper secondary level topics and is not suitable for university students. Another competitor of ours, Merge EDU is a hands-on digital learning platform that optimizes the Merge Cube to facilitate interactive learning in science and STEM subjects. It allows students to touch, hold, and interact with 3D objects and is compatible with iOS, Android, and Windows devices. However its content is also limited to upper secondary level topics and their pricing can go up to $5999 dollars a year, making it less accessible by most students. With these flaws in these applications in mind, we developed BioLabz to address the gaps by having a broader range of biotechnology topics, integrating virtual lab features and being affordable for students. These advantages positions BioLabz over our competitors and make us a comprehensive solution and stand out more in the market.

Existing manual lab   Step Into Biology

Merge EDU

Table 1: Comparison of existing systems

Features	Step Into Biology	Merge EDU	BioLabz
Virtual Lab Simulation	No	Yes	Yes
Educational Content	Up to upper secondary level	Up to upper secondary level	Up to university level
Visualization Feature	Yes	Yes	Yes
Cost	$150 a year to access all their content	$5999 a year for a complete package	Free for students
Content Coverage	Basic biology concepts	General STEM topics	Broad range of biotechnology topics
Gamification	No	No	Yes
Personalised Learning	No	No	Yes

3. Proposed System

The proposed BioLabz system will utilize the phone's camera to visualize and simulate the virtual lab. That being said, the system itself supports both Android and IOS to make it more flexible for the students and the lecturers. Once logged in, students will be presented with 3 options with their own features respectively which are the visualization feature, the game feature and the virtual lab feature.

In the visualization features, students will be able to choose from multiple different topics such as deoxyribonucleic acid (DNA), animal cells and plant cells to create a 3D model of in order to visualize and give the students a better representation of that cells and help them understand and and get a better grasp of what the cell actually looks like.

Moving onto the next feature, the game feature allows students to choose from a variety of different topics to choose from ranging from biotechnology, molecular biology, and microbiology. The students are then able to play the games that will test their knowledge by having them name the cells or even complete certain virtual labs simulation on that following topic as well as teaching them through a gamified system. The levels provided will start off easy teaching students the basics on that following topic and will get progressively harder as the students complete the previous levels.

In the virtual lab feature, students will have access to 2 different kinds of labs which are the class-oriented labs and self-oriented labs. The self-oriented labs will allow students to do their laboratory anywhere and anytime with the main purpose of teaching the students on how to do the laboratory work. Students who face many troubles while doing the self-oriented labs will be given hints as to how to complete and how to do the lab. The class-oriented labs however will allow students to do the labs prepared by the lecturers that are already tailored to fit the needs of their students.

Besides that, lecturers could also utilize the system in order to grade their students, identify areas where students are struggling and provide tailored feedback to address those weaknesses. That being said, the system will allow lecturers to create a classroom and invite their students into that classroom. Lecturers will then be able to grade their students' lab and check onto the students progress on that topic. Other than that, lecturers will also be able to create their very

own laboratory experiments that can be tailored to address the topics their students struggle with. Lecturers will then be able to post this laboratory work as a homework on the classroom feature or even display a qr code in class so that they can do their in-class laboratory work.

Overall, the Biolabz system is designed to give students a more engaging and interactive way of learning by combining the visualization, gamified and virtual lab simulation. By integrating flexibility and tailored virtual labs, BioLabz not only ensures that students will understand those topics but will also prepare them for the real-world scientific challenges, making it an important tool for modern studies.

4.   References

[1] Wahyu, Y., Suastra, I. W., Sadia, I. W., & Suarni, N. K. (2020). The effectiveness of mobile augmented reality-assisted STEM-based learning on scientific literacy and students' achievement. *International Journal of Instruction, 13*(3), 343–356. Retrieved from https://eric.ed.gov/?id=EJ1259691

[2] *Hands-on augmented reality for education*. (n.d.). Merge. https://mergeedu.com/

[3] *Step into Biology*. (n.d.). https://www.stpn2.com/

[4] Learnlight. (2023, October 21). *5 Benefits of Gamification in Learning | LearnLight*. https://www.learnlight.com/en/articles/5-benefits-of-gamification-in-learning/

Appendices

Appendix A

> **can you give info on our competitors which are Step Into Biology and MergeEdu**

> **Step Into Biology** and **Merge EDU** are two prominent educational platforms that utilize augmented reality (AR) to enhance learning experiences in biology and STEM subjects. Here's an overview of each:
>
> **Step Into Biology**
>
> *Step Into Biology* is an AR-based educational app designed to bring biology concepts to life through immersive field trips. It offers a range of interactive experiences, including explorations of animal and plant cells, DNA replication, and more. The app is free for students and is available on both iOS and Android platforms. APPLE
>
> **Key Features:**
>
> - **AR Field Trips:** Provides engaging AR experiences that allow students to explore various biology topics interactively.
> - **Multiplayer Functionality:** Supports collaborative learning by enabling multiple users to participate in the same AR experience simultaneously.
> - **Lesson Plans:** Offers free lesson plans to assist educators in integrating the app into their teaching strategies. STEP INTO BIOLOGY

> **Merge EDU**
>
> *Merge EDU* is a hands-on digital learning platform that leverages the Merge Cube to facilitate interactive learning in science and STEM subjects. It provides over 1,000 digital teaching aids and more than 100 interactive science simulations, allowing students to touch, hold, and interact with 3D objects. The platform is compatible with various devices, including iOS, Android, and Windows. MERGE
>
> **Key Features:**
>
> - **Interactive Simulations:** Offers a wide array of science simulations that enable students to explore complex concepts through hands-on interaction.
> - **3D Object Interaction:** Allows students to manipulate and examine 3D models of scientific objects, enhancing spatial understanding.
> - **Cross-Platform Compatibility:** Ensures accessibility across multiple devices, including smartphones, tablets, and computers.

Appendix B

> How AR in education in biotechnology virtual lab simulation benefits studetns?

AR in biotechnology virtual lab simulations offers several key benefits for students:

1. **Safe Learning Environment**: It allows students to conduct virtual experiments in a risk-free setting, removing the dangers and limitations associated with physical lab setups.

2. **Enhanced Understanding**: The app uses 3D visualizations to simplify complex biotechnology concepts, making it easier for students to grasp difficult topics.

3. **Broader Topic Coverage**: It covers a wide range of biotechnology subjects, ensuring students get a comprehensive learning experience.

4. **Encourages Independent Learning**: By making the learning process interactive and engaging, it motivates students to study effectively and independently, boosting their confidence and interest in the subject.

Would you like me to add more detail or focus on specific features?

Project Schedule

Phase	Tasks	Start Date	End Date
Phase 1: Planning	Research on Augmented Reality (AR) systems	Dec 11, 2024	Dec 14, 2024
	Identify client and project scope	Dec 14, 2024	Jan 17, 2025
Phase 2: Research	Find related resources and know existing system	Dec 19, 2024	Dec 21, 2024
	Analyze competitor (Step Into Biology, Merge EDU)	Dec 25, 2024	Dec 30, 2024
	Collect information from client	Jan 1, 2025	Jan 1, 2025
	Complete the proposal	Jan 5, 2025	Jan 14, 2025
Phase 3: Design	Develop AR prototype of proposed system	Jan 15, 2025	Jan 22, 2025
Phase 4: Video	Record presentation video of the system	Jan 23, 2025	Jan 23, 2025