

**Project ID:**

24-25J-220

1. Topic (12 words max)

**BioZ – An Ontology Driven Self-Learning System For Advanced Level Biology Students.**

2. Research group the project belongs to

**Autonomous Intelligent Machines and Systems (AIMS)**

3. Research area the project belongs to

**E-learning and Education (ELE)**

4. If a continuation of a previous project:

Project ID	-
Year	-

5. Brief description of the research problem including references (200 – 500 words max) – references not included in word count.

Self-learning is a critical aspect for students to deepen their knowledge, yet there is a noticeable gap in web applications specifically tailored for Biology students. While some platforms exist, they often lack the efficiency and accuracy required to truly support personalized learning.<sup>[1]</sup> One significant research problem is the absence of a collaborative environment where students can discuss topics and customize content based on their interests. This gap hinders the ability of students to engage deeply with the subject matter and learn in a way that aligns with their unique needs and preferences.<sup>[2]</sup>

Another pressing issue is the lack of attention to the emotional well-being of students in existing e-learning platforms.<sup>[3]</sup> Most current tools do not consider the stress levels or emotional states of students, which are crucial factors in the learning process. Without this consideration, the platforms fail to adapt to students' needs in real-time, potentially leading to burnout or disengagement.<sup>[4]</sup>

Moreover, existing tools often struggle to provide accurate and relevant data, especially when focusing on a single domain like Biology. This inaccuracy limits the effectiveness of the learning experience, as students may not receive the precise information they need to progress. Additionally, there is a significant gap in the ability of these platforms to offer detailed analytics and reports that accurately reflect a student's performance. Without this data, it becomes challenging to recommend personalized learning paths that are tailored to a student's specific knowledge level and learning needs.<sup>[5]</sup> <sup>[6]</sup>

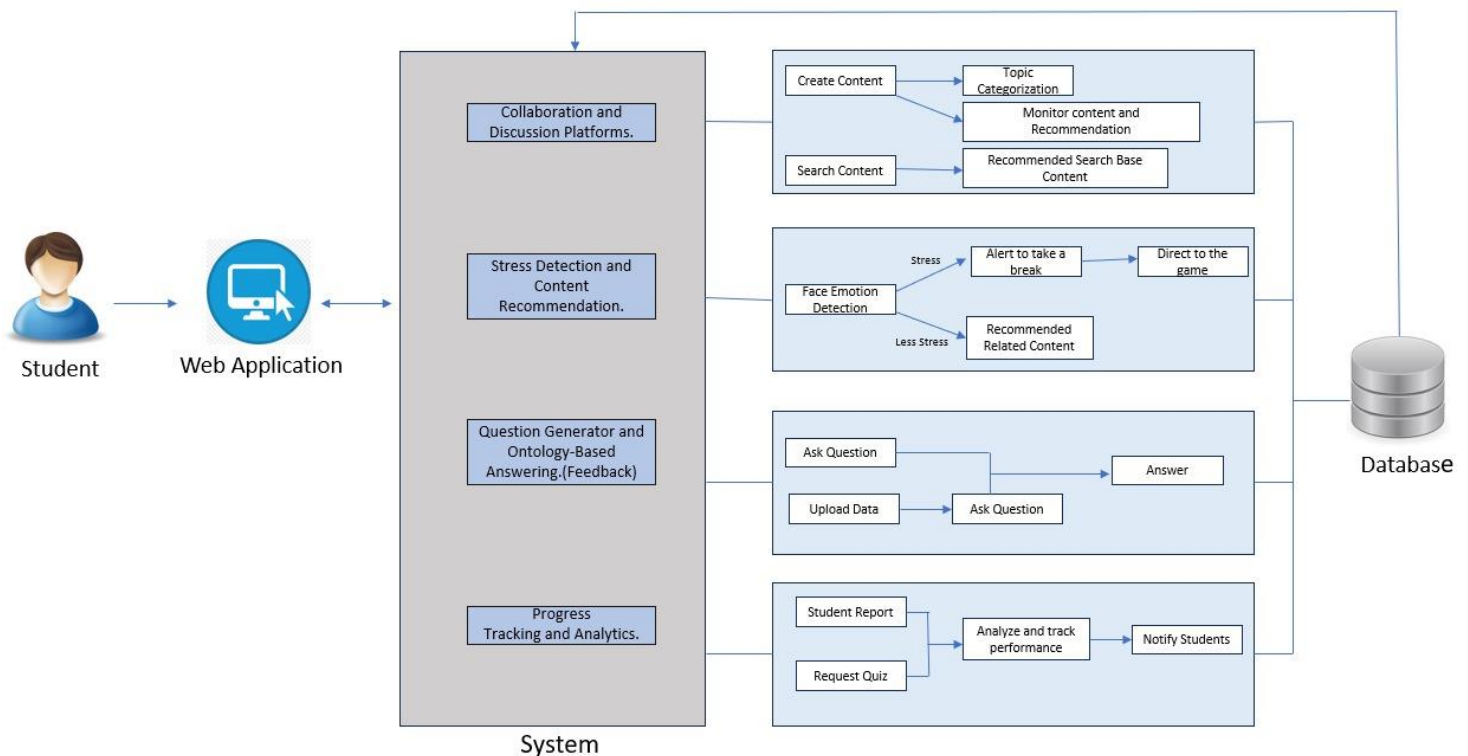
Addressing these research problems is essential to developing a more effective and supportive learning platform for Biology students, one that enhances self-learning, promotes emotional well-being, and provides accurate, personalized educational experiences.

#### References

- [1] Ashrafi, M., et al. "AI-Based Personalized E-Learning Systems: Issues, Challenges, and Opportunities." *IEEE Access*, 2024. DOI: 10.1109/ACCESS.2024.3058623
- [2] Bekmanova, K., et al. "Crafting Personalized Learning Paths with AI for Lifelong Learning: A Systematic Literature Review." *Frontiers in Education*, 2023. DOI: 10.3389/feduc.2023.00123.
- [3] Kumar, R., et al. "AI-Based Facial Expression Recognition for Real-time Emotion Detection in E-learning Platforms." *IEEE Transactions on Affective Computing*, 2024. DOI: 10.1109/TAFFC.2024.3025698.
- [4] Valenzuela, M., Flores, A. "How Personalized Learning Platforms Could Improve Social-Emotional Skills." *Frontiers in Psychology*, 2023. DOI: 10.3389/fpsyg.2023.00789.
- [5] Liu, X., et al. "Design of AI-based Self-learning Platform for College Students." *IEEE Xplore*, 2023. DOI: 10.1109/EDUCON.2023.9123456.
- [6] Yang, J., et al. "AI-Based Personalized E-Learning Systems: Issues, Challenges, and Solutions." *IEEE Access*, 2022. DOI: 10.1109/ACCESS.2022.3158597.

#### 6. Brief description of the nature of the solution including a conceptual diagram (250 words max)

The problem centers on developing an intelligent e-learning system designed to teach biological concepts by accurately understanding and answering student questions while guiding their learning based on their current knowledge. This involves challenges in knowledge representation, where the system must effectively organize and manage a detailed domain ontology that maps the relationships between various biological concepts. Additionally, it requires advanced natural language processing to create templates that can recognize and categorize the diverse ways students might phrase their questions. The system also needs strong semantic understanding and logical reasoning capabilities to correctly interpret and respond to questions by referencing the biological knowledge map. Furthermore, it requires sophisticated user modeling and adaptive learning techniques to track each student's progress and personalize the learning experience to meet their specific needs. This interdisciplinary problem blends AI, educational technology, and user-centric design, aiming to build a system that can replicate the adaptive, responsive nature of a human tutor, making it a complex and multifaceted challenge in the field of biology education.



7. Brief description of specialized domain expertise, knowledge, and data requirements (300 words max)

To build the described intelligent learning platform, specialized domain expertise in several areas is crucial. Firstly, expertise in Educational Technology (EdTech) is needed to design a user-friendly platform that meets the needs of students and educators. Knowledge of Ontology and Semantic Web Technologies is essential to effectively organize and categorize discussions, learning materials, and student progress based on specific topics. This involves creating and managing a structured framework of knowledge that the system can use to understand and process content meaningfully. Additionally, it is necessary to enable the system to analyze discussions, categorize content accurately, and adapt learning experiences based on emotional feedback.

Data requirements include a comprehensive ontology that represents the subject matter covered on the platform, student interaction data (such as questions asked, content viewed, and quizzes taken), and data on emotional responses inferred from facial expressions. This data helps the AI-driven analytics to identify learning patterns, predict trends, and generate reports that can spot issues like declining performance or difficulties in specific subjects. Furthermore, the platform needs to manage large volumes of educational content, student-generated materials, and interaction data securely and efficiently, ensuring that all data is used ethically and in compliance with privacy regulations. This combination of expertise and data enables the platform to deliver a personalized, adaptive, and engaging learning experience.

**8. Objectives and Novelty**

<b>Main Objective</b> Design an engaging and efficiently structured self-learning system for advanced-level Biology students, incorporating ontology-based methods.			
Member Name	Sub Objective	Tasks	Novelty
Nirmalaraj ANC (IT21279248)	Collaboration and Discussion Platforms.	Facilitate communication and knowledge sharing among students. By integrating ontology, the platform can organize and categorize discussions based on specific topics, analyze content for accurate categorization, and monitor discussions to ensure relevance and productivity. A suggestion engine recommends relevant threads based on students' learning progress and focus, enhancing the personalization and efficiency of the learning experience.	<ul style="list-style-type: none"> <li>• Automatic Categorization.</li> <li>• Interaction Based Recommendations.</li> <li>• Semantic Search Based Recommendations.</li> </ul>
Mohanarajakumar N (IT21331954)	Stress Detection and Content Recommendation.	Based on emotional feedback, specifically stress levels inferred from facial expressions, the learning system should adapt its content delivery. If a student is detected to be stressed, the system should suggest taking a break and offer options to engage in games for relaxation. Conversely, if a student appears stress-free, the system should recommend additional related content, utilizing ontology concepts to identify and serve educational materials that align with the student's current learning pattern.	<ul style="list-style-type: none"> <li>• Emotionally Responsive Learning Path.</li> <li>• Ontology based content recommendation.</li> <li>• Dynamic Interactivity based on student's emotion.</li> </ul>

Denitta S (IT21336904)	Question Generator and Ontology Based Answering. (Feedback)	This approach allows students to drive the learning process by asking questions and seeking information directly from the system, which responds intelligently with structured information beyond basic scripted replies. Additionally, the system should enable students to upload lecture slides and interact with them directly on the platform. This feature empowers students to engage with course materials actively and at their own pace, fostering a more personalized and effective learning environment.	<ul style="list-style-type: none"> <li>• Lecture Slide Integration.</li> <li>• AI-Driven Question Generation.</li> <li>• Ontology based Answering Mechanism.</li> </ul>
Tharulan V (IT21275760)	Progress Tracking and Analytics.	Generate quizzes in specific using Ontology concepts. Use ontology to gather and organize data on student progress, then apply AI to find patterns, predict learning trends, and create helpful reports. AI-driven analytics can also spot potential issues, like when a student's performance drops or if they're struggling with specific subjects.	<ul style="list-style-type: none"> <li>• Generate quizzes on a specific field.</li> <li>• Analyze student's performance and generate report.</li> <li>• Recommend content based on his knowledge driven by Ontology.</li> </ul>

**9. Supervisor checklist**

- a) Does the chosen research topic possess a comprehensive scope suitable for a final-year project?

Yes		No	
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- b) Does the proposed topic exhibit novelty?

Yes		No	
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- c) Do you believe they have the capability to successfully execute the proposed project?

Yes		No	
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- d) Do the proposed sub-objectives reflect the students' areas of specialization?

Yes		No	
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- e) Supervisor's Evaluation and Recommendation for the Research topic:

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**10. Supervisor details**

	Title	First Name	Last Name	Signature
Supervisor	Dr	Udugoda Udumaprawage	Samantha Kumara Rajapaksha	
Co-Supervisor	Ms	W.A. Chamali	Pabasara	
External Supervisor	Mr	Gajarthan	Thevarajah	
Summary of external supervisor's (if any) experience and expertise Co-Founder and CEO – Bohar IT Solutions.				

**This part is to be filled by the Topic Screening Panel members.**

Acceptable: Mark/Select as necessary

Topic Assessment Accepted	
Topic Assessment Accepted with minor changes (should be followed up by the supervisor)*	
Topic Assessment to be Resubmitted with major changes*	
Topic Assessment Rejected. Topic must be changed	

\* Detailed comments given below

Comments

The Review Panel Details

Member's Name	Signature

**\*Important:**

1. According to the comments given by the panel, make the necessary modifications and get the approval by the **Supervisor** or the **Same Panel**.
2. If the project topic is rejected, identify a new topic, and follow the same procedure until the topic is approved by the assessment panel.