



BIOINFORMATICS EDUCATION

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BIOINFORMATICS EDUCATION

Introduction

Bioinformatics Education

Bioinformatics education is a science of teaching and learning using computers and information technology to solve biological problems (Sari et al., 2022; Koch & Fuellen, 2008). This means that bioinformatics education can include knowledge and skills from biology, mathematics, statistics, physics, chemistry, medicine, pharmacology, computer science, and information technology (Ranganathan, 2005). Efforts to integrate bioinformatics education effectively are a big challenge (Brass, 2000).

Science, Technology, Engineering, and Mathematics (STEM) are areas of content that are closely intertwined with each other. STEM integration is an excellent way to understand complex reciprocal relationships in the context of real-world problem-solving (Chai, 2009). So that increasing STEM literacy for prospective biology teachers is a challenging effort for educators and researchers. Joyner & Parks (2023) mentions that the goal of enhanced pedagogical development to address undergraduate science, technology, engineering, and mathematics (STEM) literacy development is well recognized. However, the methodology and application to implement such lessons can take time and effort. Prospective biology teachers are an important target in integrating formal bioinformatics education with STEM literacy.

Reference:

- Brass A (2000). Bioinformatics education—a UK perspective. *Bioinformatics* 16, 77–78.
- Chai, C. S. (2019). Teacher professional development for science, technology, engineering, and mathematics (STEM) education: A review from the perspectives of technological pedagogical content (TPACK). *The Asia-Pacific Education Researcher*, 28(1), 5-13.
- Joyner, J. L., & Parks, S. T. (2023). Scaffolding STEM Literacy assignments to build greater competence in microbiology courses. *Journal of Microbiology & Biology Education*, 24(1), e00218-22.
- Koch I, Fuellen G (2008). A review of bioinformatics education in Germany. *Brief Bioinform* 9, 232–242
- Ranganathan S (2005). Bioinformatics education—perspectives and challenges. *PLoS Comput Biol* 1, e52
- Sari, I. J., Vongsangnak, W., & Pongsophon, P. (2022). The Effect of Bioinformatics Module on Molecular Genetics Concepts on Senior High School Students' Computational Thinking Skills. *Shanlax International Journal of Education*, 10(2), 9-17.

Based on the precedent above, let's try to make interesting variations of bioinformatics learning for students in school, especially for high school students who will learn Genetics, Evolution, or the role of genetic engineering.



Follow this step by step:

1

Analyze the Learning Outcomes and high school materials that are appropriate for the application of bioinformatics in biology learning activities



Learning Outcomes	Materials Biologists

2

Determine the bioinformatics tools that can be used for designed biology learning
Please learn one by one and apply it to a learning design that makes you comfortable and exciting



BLAST

Basic Local Alignment Search Tool



3

Find and analyze *biology as science* research articles that use bioinformatics methods, and demonstrate the application of bioinformatics in the article.

Article Title:

Article Summary:

Research Methods on Articles:

Bioinformatics Tolls Used:

Conclusion after demonstrating Bioinformatics Tools:

Design of Bioinformatics Methods and Tools to be Used for Learning:

4

Learn about the STEM literacy domain, decide on one STEM literacy domains that you think can increase the effects of bioinformatics learning and create instruments



STEM Literacy Domain	STEM Literacy Indicators
Knowledge of STEM	Understanding STEM Concepts
	Understanding STEM Characteristics
	Explanation Using STEM Concepts
	Identifying STEM-related Issues/Concepts
	STEM Applications
	Decision
	Troubleshooting
Attitudes Toward STEM	Attitudes Toward STEM
	Careers Focused on STEM
	Connecting STEM with Society/Economy/Environment
	Participate in STEM Issues or Culture
STEM Skills	STEM Process/Practice
	Focused STEM Career Practices
	21st Century Skills STEM Practice
	Integration/Learning (Creative Thinking/Innovative Thinking)

Usable Instruments:

How to Process Grades:

5

Design learning activities using bioinformatics in biology learning activities by filling in the beginning, core, and closing activities



Please choose one of the learning models for bioinformatics learning:

- Inquiry based learning (<https://files.eric.ed.gov/fulltext/EJ1053967.pdf>)
- Computer inquiry based-teaching (<https://files.eric.ed.gov/fulltext/EJ1328112.pdf>)
- Project based Learning
(<https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1005620>)
- Problem based learning
(<https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1006746>)

Initial Activities

Core Activities:

Closing Activities:



6

Please Test your design in front of your classmates, and ask for their opinions as an assessment and improvement material