

A Formal Justification for Teaching Evolution Using Online Resources

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Introduction

The project created and justified in this paper is a fully online module, made using Moodle, for teaching evolution to high school biology students. The module contains lessons on evidence for evolution, natural selection, and evolution in action. It includes such teaching resource as tutorials, web pages, interactive simulations, and videos. Student collaboration, communication, and formative evaluation is done through blogs, discussion forums, a WebQuest, email, and text documents. A final activity where students use their ingenuity to create a brand new organism serves as a summative assessment. This project will be implemented in a fully online Biology course that will be offered by Grand Rapids Public Schools beginning in 2010.

Providing Motivation

Motivation is paramount to student achievement. Many very intelligent but unmotivated students have underperformed in traditional classes. Likewise, an overachieving student is very likely to have found some motivating factor that drove him to success. This project uses several motivational factors to enhance student performance and achievement.

- 1) *The 5E Method.* Developed by BSCS, this method of instruction uses principles of scientific inquiry and constructivist philosophy to build students knowledge and understanding of scientific concepts. It is based around 5 themes, or phases of a lesson: Engage, Explore, Explain, Elaborate, and Evaluate. BSCS summarizes it's instructional model in the following table (Bybee, Taylor, Gardner, Van Scotter, Powell, Westbrook, Landers, 2006).

Phase	Summary

Engage	The teacher or a curriculum task accesses the learners' prior knowledge and helps them become engaged in a new concept through the use of short activities that promote curiosity and elicit prior knowledge. The activity should make connections between past and present learning experiences, expose prior conceptions, and organize students' thinking toward the learning outcomes of current activities.
Explore	Exploration experiences provide students with a common base of activities within which current concepts (i.e., misconceptions), processes, and skills are identified and conceptual change is facilitated. Learners may complete lab activities that help them use prior knowledge to generate new ideas, explore questions and possibilities, and design and conduct a preliminary investigation.
Explain	The explanation phase focuses students' attention on a particular aspect of their engagement and exploration experiences and provides opportunities to demonstrate their conceptual understanding, process skills, or behaviors. This phase also provides opportunities for teachers to directly introduce a concept, process, or skill. Learners explain their understanding of the concept. An explanation from the teacher or the curriculum may guide them toward a deeper understanding, which is a critical part of this phase.
Elaborate	Teachers challenge and extend students' conceptual understanding and skills. Through new experiences, the students develop deeper and broader understanding, more information, and adequate skills. Students apply their understanding of the concept by conducting additional activities.
Evaluate	The evaluation phase encourages students to assess their understanding and abilities and provides opportunities for teachers to evaluate student progress toward achieving the educational objectives.

Because this method of instruction elicits prior knowledge, allows students to recognize and address their own misconceptions, and delivers content that is relevant to the learner's experiences, it does a great deal to increase the motivation to learn new concepts. The increased motivation is evidenced by the enhanced mastery of subject matter by students who learn in this fashion. Several studies have found that students who experienced cyclic approaches to teaching subject matter, such as the 5E Method, had greater gains in subject matter knowledge than students taught by traditional approaches (Bybee et al., 2006).

2) *Differentiated Instruction*. According to Dr. Howard Gardner, there are eight different intelligences. Most schooling, however, focuses on only two types: linguistic and logical-mathematical (Armstrong, 2000). This project addresses these two intelligences, but goes well beyond.

Examples include:

- Intrapersonal Intelligence: Recognizing self knowledge in the blogs and discussion forums.
- Interpersonal Intelligence: Learning from others in discussion forums and blogs, and working cooperatively in groups.
- Spatial Intelligence: Studying as well as creating original pictures, graphs, and charts, as in the final assessment project.
- Musical Intelligence: Composing music or writing an original song for one of the projects.
- Naturalist Intelligence: Recognizing the changes in species over time, or predicting future change, as in the Peppered Moth activity.

By differentiating the learning and assessment experiences of the students, motivation has also been provided for learners who are strong in other, non-traditional, forms of intelligence.

3) *Use of Technology.* In their homes, most students experience an abundance of technology. It is not uncommon for students to have cell phones, computers and televisions to communicate and experience multimedia. Many classrooms are dramatically different, and few of the technological aspects of the outside world are incorporated into lessons. This project employs the types of technology students use outside of school to facilitate learning. By incorporating blogs, discussion forums, videos, websites, and creation tools such as Windows Movie Maker and Google Sites as part of the learning experience, students will be more motivated because of the increased relevance to their daily lives.

- 4) *Social Learning.* With the rise of websites like Facebook, MySpace, YouTube, and Flickr, it is evident the world is becoming more social. By incorporating sociality into the lessons, like collaborating on a WebQuest, sharing thoughts in a blog, or sharing an original creation in the final assessment, this project provides motivation to students by mirroring the world outside of school.
- 5) *Performance-Based Assessments.* Far too many teachers rely solely on standardized or other types of written tests to assess student learning. Unfortunately, it has been established that these types of tests do not always give an accurate measure of how well students understand a given concept (Haladyna, Nolen, Haas, 1991). Moreover, students are more likely to find a performance-based assessment, not a standardized test, more meaningful (Linn, Baker, Dunbar, 1991). The meaningfulness of the performance-based assessments included in this project, such as the creation and explanation of a fictional organism, supply the learners with far more motivation to succeed than answering questions on a standardized test.

Online Presence

It can be very easy to feel lost and alone in an online course. Therefore it is vital for a teacher or facilitator to create an atmosphere of community. This project has used several methods to accomplish this task. First, the video at the beginning of the module showcases a teacher who warmly greets students and discusses the upcoming unit. This serves the purpose of showing the students that there is a real person who oversees the course and their learning, as well as someone who can provide guidance and help if they need it.

Furthermore, once the students begin the module, they are not alone. There are several activities and assignments where students collaborate, or at the very least communicate. Three of these activities include the learners posting ideas or thoughts on a discussion forum or blog, while others write back a response. Another assignment, the Evidence for Evolution WebQuest, places students in groups to interpret different pieces of information. They then collaborate on creating a presentation. This collaboration and discussion is critical to making students feel that they are part of a community and creating an online presence.

Free/Accessible/Durable Resources

There is a vast abundance of educational resources, websites and programs available to today's learner. Therefore it is necessary for teachers to carefully select those that are the most suitable for their needs. Resources that are free, can be accessed anytime from anywhere, and are likely to exist for a significant time, should be used above all others (Dickson, 2009).

The following major resources employed in this project follow the above guidelines.

- 1) *Moodle*. This project was developed and implemented using Moodle. This software meets the criteria because it costs nothing, has existed since 2002 with increasing use each year, and can be accessed from any computer with an internet connection (Dougiamas, 2009).
- 2) *Evidence for Evolution WebQuest*. This resource is free, will be online indefinitely, and can be accessed from any computer with an internet connection.
- 3) *Edublogs and Google Sites*. Although both of these resources require a subscription, they are still free. Like those listed above, they are likely to exist well into the future, and they can be accessed from any computer with an internet connection.

Creating Possibilities

The concept of biological evolution has been taught many different ways in many different classrooms for many years. However, never has it been taught face to face in such a way as allowed by this project. The mere fact that all the learning material is presented online gives the students a great deal of flexibility, as they can access the material when it is convenient for them and at their own pace. This project also takes all that the web has to offer on the subject of evolution, and narrows it to the most appropriate and useful resources. While many classrooms are not equipped to bring these types of resources to the students, this project brings the students to the resources. Furthermore this project takes the isolation out of online learning and fosters communication and collaboration through the use of discussion forums, blogs, and a group project. And most importantly, this project uses web based tools to create a meaningful and relevant project based assessment that sums up everything the students learned. The experience of learning about biological evolution from this project could not be duplicated in a face to face classroom.

Conclusion

This project is rooted in the principles of excellent teaching. It is inquiry based, which makes learning more relevant and meaningful. It promotes creativity and collaboration, which are essential skills for those competing for modern jobs. The project also utilizes cutting edge technology and up to date resources that are beyond the realm of what can be done in traditional classrooms. Lastly, it meets or exceeds the standards set by the State of Michigan for teaching Evolution, and the Michigan Merit Curriculum Guidelines for the Online Experience. Without a

doubt, learners who use this project will be rewarded with an experience unmatched by anything else.

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