http://aif-doi.org/lnssh/020136

Chapter 76: Designing a Biology Website that Contains Scientific Research, Simulation Experiments, Working Papers and Scientific Videos

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Introduction

My project is about designing a Biology website that contains scientific research, simulation experiments, working papers and scientific videos.
I will create a website for high school students interact with it to learn Biology and use to reference their research papers. It will consist of several different aspects such as scientific research, simulation experiments and series of videos regarding the different topics within Biology.
In the Kingdom of Saudi Arabia there is no interest in scientific research so a student can reach Graduate Studies without being able to write a good introduction to a certain subject. Scientific research gives students information and background about the subject. To start with the process of introducing research papers into my school or education system in KSA, we need to break down how we will do this. Firstly, to incorporate what a research paper is, we must develop the process. First, explain to them what a research paper is. Next, explain, why we use these papers and how they are used in the real world. Next, we can show them how they can read a research paper. Next, we can teach them how to fill out or complete them, for example how to gather data on that topic and record it, and then how to interpret or read the to make a conclusion.
The great number of students in a class which can reach 45 students and the fact that there are many needed tools that are not available to do experiments. I also have noticed in our physics class that our teacher uses a website called phet which contains a lot of simulation experiments. Those experiments on the website reduce the time and effort required when doing them in real life.
Working papers and scientific videos are among the important factors that help students get the information they want in an organized and accurate manner.
There are many barriers to building this website and the most important is the need to make a computer or laptop available to each student. Also needed are translators and choosing the scientific research and experts to design and perform the experiments. We also need to organize online courses for the teachers to help them in scientific research and how to write it. We need the support of the ministry to achieve all that.

1. The Problem & Solution

PROBLEM:
Studies have shown that the existing high school biology curriculum in Saudi Arabia fails to attain its goals in three major areas; namely:

- It fails in relaying the fundamental concepts of the subject to students

- More importantly, it fails to help students develop an inquisitive and critical mindset or problem-solving skills tools needed for scientific research.
- Lastly, it fails to instill in students ethical values related to the subject, particularly environmental ethics such as the tradition deeply rooted in Arabic culture of love for environment and the importance of sustaining it (Al Fowehi *et al*, 2010).

This is a serious problem. It has come to the point where even a graduate student has no interest in scientific research whatsoever: unable even to write an introduction to a subject that he studies or to analyze and draw conclusions from a set of data. This means that the country is on the receiving end of the science supply chain; not contributing to it in any significant or meaningful way. If that supply chain is broken for any reason, academic life will come to a standstill, and all facets of life, especially the economy, will suffer.

This is not due to lack of resources. Advancement in science needs three components in order to thrive: financing, intellectual capital, and an effective educational system within a culture that promotes such advancement and rewards it.

Saudi Arabia is known for its strong economy (Timewell, 2012), while Arab students (including Saudis) excel in scientific research and academia when studying and living abroad. We are left with the conclusion that it is the pervasive culture or the educational system or both that preclude advancement in scientific research (Indonesian paper about scientific process).

SOLUTION:

The proposed solution is finding ways to instill scientific curiosity in students, provide them with, and train them to use, the tools necessary for scientific research, and make them aware of the ethical side of science. One way of doing this is using the internet. For the subject of Biology, it is proposed that a website be developed that contains scientific research, simulation experiments, working papers, and scientific videos for the benefit of students.

This is a very ambitious project considering that most of published experiments have focused on only one of the aforementioned components like scientific videos or simulation experiments.

2. Underpinning Philosophy

My proposed solution is rooted in the rational /technical philosophy of education, which states that education should revolve around curriculum, which should be planned carefully in units and lessons that have a specific order starting from basic skills and facts and reaching a stage of critical thinking and understanding. The end result of this way of education should then be measurable. This places a burden on the lesson and unit designer to present, who could very well be the educator, to present his knowledge and skill material in a logical order that ensures the gradual sophistication of the student who will add up pieces of knowledge and skill to attain a wider and more comprehensive understanding.

This philosophy perspective is obviously controlled by curriculum specialists and aims at promoting efficiency in teaching and learning. Examples of this philosophy perspective are: lesson plans, focusing on goals and assessments, mastery learning, SRA kits, and management by objective. Among this philosophy perspective`s supporters are such names as Ralph Tyler, Hilda Taba, Benjamin Bloom and Grant Wiggins (Phil Tate, 2017).

So how is our proposed solution connected to this philosophy perspective? We are proposing to design and build a biology website that will contain scientific research, simulation experiments, working papers and scientific videos. The material on the website should be relating directly to

the curriculum and include extracurricular material as well. The material relating directly to the curriculum should help students obtain a better grasp on the topics they are studying in more details, while the extracurricular material should allow the students to expand their horizons in an engaging and captivating way. This being a Worldwide web tool, the hyperlinks from one item to another should be planned carefully to progress naturally from the basic to the more detailed; so that students could have the choice to stop at their desired level of sophistication without feeling any gaps in knowledge or skill. This necessitates a great degree of cooperation between curriculum and lesson designers and web designers.

3. Prior Research

Numerous scholarly articles support my proposed solution. For example, Mahmood Khalil *et al* (2014) write that it is important to include both science-technology content and pedagogical content knowledge in high school science curricula in a continuously interactive way that will ensure relevance to the needs of students. The authors discuss learning units (which relate to our chosen rational/technical philosophy perspective) including science, technology and societal issues and also talk about learning setting which include computer episodes. The authors propose that this approach will help students achieve science-technology literacy that is intimately connected with societal issues, which in turn will help students find future jobs that will help advance the society. Their conclusions draw from, and lend support to, Dreyfus (1995) work which stressed on the importance of morals and ethics in education.

Another scholarly article that relates more directly to our subject is the work of Siti Hadiati Nugrainia *et al* (2013). This work discusses feedback from students relating to a biology website design and development. The aforementioned website is called e-AV Biology and serves the needs of senior high schools in Indonesia. This website was mainly concerned with only one of the facets that our proposed website would handle, namely video lessons, along with supporting tools such as the Interactive Quiz and Discussion. The study discussed examples of the video lessons on topics such as Renewable Energy in the field of Biotechnology Industrial which is ordinarily a difficult subject to visualize and understand. But the main purpose of this study was to examine the design—including features, interactivity and video content) and the effectiveness of e-AV Biology Website in helping students learn. So a sample of 256 high school students were chosen in the year 2011 to participate in a study comparing between the traditionl way to teach biology and the full multi-media instruction method using the e-AV biology website. The findings showed a positive feedback favoring the e-AV teaching method.

Another paper, written by Ahmad Fauzi *et al* (2018), maps some of the biology topics that are taught in high school but are considered difficult by undergraduate students. Clearly, if such topics were taught in an innovative way (e.g., using multi-media on a website) then they would have been received well and better understood by students who then wouldn`t find them difficult in undergraduate studies. The study used the survey research method, and the research subjects were biology major students of the 2017 class in a Malang, Indonesia state university. The paper concluded that Genetics, Metabolism and Cell Division were the most

difficult topics in that order taught in the 12th year of school, while the Immune System, the Coordination System, and Plant Tissue were the most difficult topics in that order taught in 11th year of school; finally, Protista, Monera, and Viruses were the most difficult topics in that order taught to students in the 10th year of school.

A very important study on the subject was the one done by Tri Eka Andini *et al* (2018). This study falls under the ``descriptive quantitative`` research category and was done to describe and quantify scientific process skills of high school students. The chosen sample were 231 high school students from two different sub-districts in Palembang, Indonesia; namely, Gandus and West Ilir. Test instruments and interviews were used to gauge students` scientific process skills, and the skills tested for were observing, grouping, interpreting, predicting, formulating a hypothesis, planning an experiment, and communicating. The results showed medium results and the study concluded that students` scientific process skills needed improvement. We think that a biology website such as the one we are proposing would be an excellent candidate for help with such improvements.

Our final example of literature supporting our proposed solution is the scholarly article written by E S Soegoto *et al (*2018). This paper describes the information technology revolution and argues that information technology is the most important sector in the economy and society. It then suggests that students need to acquire information technology skills since at least high school so that these students can help their country advance to the ranks of developed countries. The article defines electronic leaning (e-learning) as ``a modern educational system that focuses on strategies to improve the learning process`` and concludes that it is imperative to utilize information technology in the educational system, particularly for high school.

There are countless other articles that support our proposed solution, but we will make do with the ones we have discussed.

4. Action Plan

BUDGET

As we do not know beforehand what kind of reaction our proposed solution will face, or what kind of budget the project will be allotted if approved, we will plan for two extremes: a low budget which we will use in case of opposition to our project or in case of a low approved budget; and a high budget which we will use if our project was received well and approved for a high budget.

- A Once off Cost of website design and building:
  - Low end cost: **$40,000** using a freelancer.
  - High end cost:
- Design (includes page layouts and simulation experiments design): $120,000 - $140,000.
- Maintenance (depends on how well-designed the site is): $4,000 - $10,000 /annum.
- Development (coding the markup and scripting): $10,000-$15,000 /annum.
- Webmaster: $8,000/annum.
- Webhosting: $400/annum.
- Domain name registration: $200/annum.
- Material consultant: (a committee of) staff teacher(s) for free or an outsider for $25,000 - $35,000 /annum.

- Desktops: 10-30 at $700 each for a total cost of $7,000 - 21,000 Hopefully they will serve at least 4-5 years.
- A matching number of Desks and chairs 10-30 at $300 a pair for a total cost of $3,000 - $9,000.
- Lab room: provided by school.
- Lab attendant: teachers or volunteer students or paid students at minimum wage $10-15/hour. The cost will depend on the number of hours the lab will be open. If we assume it will be open for two hours a day, 5 days a week then the cost will be $12 x 10 hours per week x 30 weeks in a school year = $3,600 - 4,500/annum.
- So, our budget will be as follows:
  - **Startup costs** (once off for website design and building and, desktops and furniture): **$130,000 - 170,000**. It should be noted that the website might need to be completely overhauled or redesigned and built after a period of 5-7 years to cope with new technologies.
  - **Recurring annual costs** (staff, material and maintenance): **$51,200 - $73,100/**annum.

TIMETABLE

We will start our work immediately.

April 1, 2019 the project will be proposed to school`s science department which will raise the issue to the principal.

April 15, 2019 the school`s principal will raise the issue to the Ministry of Education.

April 16-May 1, 1019

- Meetings and negotiations with the Ministry of Education.
- At the same time a committee will be chosen from within the school to assign a project manager and a team and meet regularly to identify stakeholders and providers to save time and be able to start immediately once the project is approved.

May 15, 2019 the Ministry of Education will hopefully approve the project and provide funding.

May 15- May 30, 2019 Materials and services providers will be contact, and purchases and contracts finalized.

June 1- June 15, 2019 Work will be done on the website and preparing the lab.

June 15-September 1, 2019 School will be out for the summer, but the committee will be working with the website designers and volunteers from school staff and students to test the website.

September 15, 2019 the lab and the website will be ready the beginning of the new school year.

MARKETING

As is obvious from the action plan, the people that will need to be convinced of the project are the educational system bureaucracy. First, we will need to convince fellow biology teachers and the head of the biology department. That shouldn`t be too hard since it means an extra budget for the department and the prestige of being among the first departments that use

information technology and e-learning. The department head should then convince the school`s principal using the same arguments. Convincing the bureaucrats at the Ministry of Education might be more difficult, but the committee will have prepared a study showing the success of this method in other countries, both developing and developed, and use the argument of bringing the country`s educational system into the 21st century. We might also talk to

influential parents of some of the school`s students, convince them and ask them to intervene and use their influence to sway the vote in our favor.

The committee will also talk with businesses known for their support of the educational system and ask them to support the project materially or financially.

5. Assessment

In the beginning of the school year, before students have had the chance to use the lab and the website, we will use a Biology learning evaluation model similar to the one used by Sri Utari *et al* (2017) which is based on both the Borg & Gall model and the logic model. Data collecting will be done via observation sheets, questionnaires and tests. The purpose of the questionnaires would be obtaining information regarding the performance of the teacher, students learning performance, atmosphere in the class and scientific attitude; while the objective of the tests is to gauge the students` mastery of Biology concepts.

These first measurements will serve as the basis with which we compare results obtained from applying the same method later in the year. This method will be applied several times during the school year and the results should show us any improvement in the students` academic performance and gaining and application of scientific process tools.

Analysis of the data collected will be done by means of proper software such as Lisrel 0.80. We are quite sure that the results of the analysis will show our Biology website to be a valid tool in enhancing the leaning performance of students, the teaching performance of teachers and in helping students gain, apply and improve scientific process tools.

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