"Re-invent the wheel", a Bridge between In-seat and Online Learning

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Abstract

This paper introduces “re-invent the wheel” as a pedagogical approach. “Let them re-invent the wheel” is a teaching strategy that lets the in-seat instructor prepare one’s own students for research and online learning, to familiarize them with ethics and to prepare them for higher education as well as market. In this approach, the instructor assigns brief and non-essential parts of the course to the students to have them learn by their own and return their findings and understanding documented, where it makes the students practice in brief writing-assignments and work with software that improves their computer literacy, which are essential pieces in online learning. In this approach, instructor roles as a director in making a bridge between in-seat and online learning, that the latter one is an inevitable essential piece in today’s education. This paper outlines the advantages, outcomes and the difficulties of this approach and details solutions to address the difficulties.

Introduction

“*You do not need to re-invent the wheel*!” This very familiar and axiomatically accepted phrase, is frequently used and heard in our daily life, specifically in education. For sure it would be reasonable to assume the already proven principles and facts like foundation steps of education. In science, technology, engineering and mathematics (STEM) areas of education, where inventions and discoveries have made several different aspects, flavors and applications, these so-called wheels are spinning in each and every corner. However, education is not just instruction by provisioning a collection of knowledge and abilities and re-invention of the wheel is required, at times.

This paper addresses the “re-invention of the wheel” (RoW) as a pedagogical approach and a bridge between in-seat and online education. The philosophy of this teaching style is to enhance those dimensions of education that may enhance students’ readiness in online education through in-seat training. Technology has revolutionized the education and information is almost available everywhere, however before starting online education special preparation is required. RoW is not a redesign of teaching, but a value added piece to those aspects that were traditionally assumed. Some of these aspects are, personal research capability, critical thinking, ability to use the available online resources, team-working and leadership, ethics, finding new solution, etc.

Technical writing skill is an inevitable part of every accredited technology program. Writing is one of those skills that takes its time to come and at first it is really challenging. Short, individual or small group research projects are good practice for technical communication skills.

RoW is the story of frequent and scattered experience of involving the students in short, but challenging activities. Challenging because they learned to be note-taker in traditional learning

system. The result of this long term challenge has been exciting for the author. In this paper after reviewing the main requirements of online learning, these results are reviewed in four sections of a) personal research and creativity; b) technical writing skills enhancement; c) understanding and applying ethics and d) harmless instructor evaluation.

Main requirements of online learning

Students who take online courses for the first time, normally face challenges based on their readiness in their computer skills and learning habits. For this reason, schools mandate a number of in-seat credit hours for students before taking any courses online as prerequisite. In category of the computer skills, students needs software, hardware and internet skills. In learning habits, they needs to be self-learner, proactive learner, have proper time management skills and be self-motivated.

As online learning relies on internet connectivity, students have to be able to use internet related tools; web browsers are the most important ones. Using the learning management system for completion of the homework assignments and upload and download of the files are among the first needs of online students that is through web browsers. Besides that, in using online libraries for the textbook or research activities, students need some good knowledge of internet based access and use of search engines, online dictionaries, encyclopedias, etc. Search engines are mandatory tools for research in finding other resources. Becoming familiar with the tips and tricks of these tools is mandatory for online students.

In each and every in-seat course, students need to return assignments that are prepared using office software such as word processors, spreadsheets, drawing software, scheduling software, etc. These assignments provide good readiness for the students once they need to take online courses. Besides these software packages, there are other general utility software or gadgets such as file compressors, anti-virus utilities for secure online connection, operating system tools to manage its common problems, etc. that students have to have some basic knowledge of them.

Among the important learning habits in online learning that are discussed more in the rest of this paper are self-learning, proactive learning and time management. Once the students take a class online, they realize the importance of a good teacher. They need to learn by their own from scratch by reading the textbook, references, and other resources over internet. At times self-learning helps them pass through the borders and learn materials ahead of time, where it turns them to proactive learners.

Time management is one of those aspects that play an important role in every task. Once a student take an online course, every credit hour's required time will be magnified as they need to learn everything by their own, which demands more time to spend. For this reason, online students always feel lacking enough time to reach all of their activities. The time consuming nature and the huge load of an online course with minimal success might lead to disappointments and dissatisfaction in students. Creation of a strong self-motivation attitude reduces the disappointment risk. This attitude is created in students in the course of time with RoW based learning.

Personal research and creativity

One of the main objectives of including RoW as part of teaching approach, is construction of research, creativity and innovation in students. Considering RoW-based learning as part of the program in the early years of college to create research attitude and habit in learners can be very effective. The result of a published research that investigates whether freshmen students are as innovative as senior students in undergraduate technology and engineering schools, showed that freshmen students can generate concepts that were essentially more original than those of senior students. The research also showed that there was no difference in quality or feasibility of the concepts generated by these students [1]. In this study, innovation was measured in terms of originality of the solutions that the students proposed for an open-ended problem, as well as the technical feasibility of the solution for a given practical problem. The same study also encourages for additional studies to investigate the effect of factors such as curricula design and skill acquisition on innovation capability of students. The brilliant result of this research proves that including research in freshmen student's program is effective and it creates the research habit in them, once it continues in their whole degree program.

One of the main research facilitators in RoW-based learning is access to the research resources, library resources, online resources, etc. Luckily today, most of the freshmen college students are familiar with the search engines and the methods of search. Students can search and get brief ideas from the existing ones and add their own contribution to them. Innovation does not happen always, however the result of this approach is to turn the teacher-centered learning into student-centered learning or even self-driven learning that is very favorable for industries.

Example from an experience:

In a first step RoW-based research, for a basic electronics course requirements, electrical engineering technology students were ask to research on why Bipolar Junction Transistor (BJT) amplifies its input signal? More than 60% of the students returned the small signal models that can be found in the reference engineering books (out of the scope of engineering technology); about 15% just repeated the circuit-based equations for amplification; about 20% did not return anything and missed the point of that research activity. One group of the students returned an innovative idea in their single page research report.

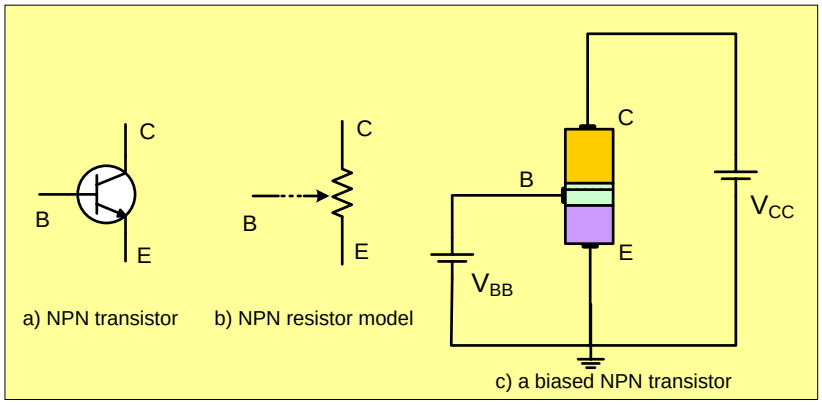

Figure 1: A simple innovative model for BJT transistor circuit using a single resistor

Their innovative idea simply modeled the transistor with a resistor that its resistance is controlled by the base current. This innovative idea after discussion with the students and some modifications has been re-sketched, and it is shown in figure 1. They model the element between the collector (C) and the emitter (E) like a variable resistor that its resistance is mainly depends on the width of the PN junction between the base (B) and the emitter (E). By increasing the current at base, the width of base-emitter decreases and consequently the current that runs between the collector and the emitter increases. Accordingly, the given current to a given load proportionally increases, which is interpreted as amplification. Although this model is not complete, however it provided a convincing reason for amplification of BJT for students.

Technical writing skill enhancement

The importance of technical communications has been stressed for engineering and technology majors in ABET documents as one of the main criterion of ABET. It is required that the graduates of the engineering programs be able to write effectively. In most of the colleges, there is a writing center, in which it helps students fix their problems with their reports and term papers. The writing centers can be a major help to the instructor to reduce the workload of grading, corrections, tutoring and assistance in the given assignments [2] [3]. Experience of working with the students of electrical and computer engineering and electrical engineering technology students shows that writing lab and project reports is one challenging piece of project. RoW-based tasks makes students work with writing centers closely for their short tasks.

The word processor software that is used to prepare the report's draft, draw diagrams, sketch the figures and finally bundling them as a final report is also another issue where students need a good preparation in them. Experience shows that one of the first challenging problems for the online learners is computer and software literacy. Luckily, many of the word processor and office software have spell and grammar checker in which they help students make a more prepared report.

Besides computer literacy and writing skill, writing according to the standard formats can be another issue. While providing a template for students and asking them to prepare according to the template looks very straight, however in its early steps it can be another challenge. Once a relevant standard format such as IEEE format is introduced and the students were told to prepare their work according to the provided template; yet placement and anchoring of the figures and tables looks tricky specifically in the first tries. To have a successful experience, the teacher needs to run a short tutoring on formatted writing and show the students how to use a template to overwrite the prepared materials and results.

In RoW approach, the students receive the writing assignment more frequently and at the end of the degree they feel to be more prepared in their technical communication skills.

Understanding and Applying Ethics

Plagiarism and cheating are detrimental and are major ethical problems in academic environments. Several solutions have been proposed to reduce the risk of cheating and plagiarism [4]. According to the released research results, engineering and technology undergrad

students are the most likely amongst the others to cheat [5]. This research studies attitude towards different types of cheating [5]. Specifically in research, plagiarism has substantial consequences for the researchers, their team and their affiliated organization. Training undergraduate students about the harmful impacts of plagiarism during their RoW-based research assignments is one approaches to reduce this risk.

RoW-based teaching is basically a good means for anti-plagiarism training. Experience shows that in the first research assignments, many students receive advice once receiving their graded short paper. The same experience shows that the problem is gradually rectified. Explaining the purpose of the RoW-based research assignment, the importance of honesty and the destructive effects of cheating, awarding the honest students in class, in department and at school, etc. are among the possible ways to applaud their honesty and to suppress cheating.

Research results shows that stressing on academic integrity code in order to reduce the risk of cheating can sensitized the students to the value of ethical behavior while in school and they will carry this ethical behavior over to their profession. This can also be used to introduce the basic concepts of professional engineering ethics [6] [7].

Harmless Instructor Evaluation

Instructor evaluation by students or through peer reviews is a pretty common routine in all schools, for full time and adjunct faculties. Part of this evaluation is related to the instructor effectiveness that shows how the instructor was successful in teaching.

An instructor may evaluate his or her own effectiveness after assignments, quiz, tests, or any instruction, explicitly or implicitly. One approach for self-evaluation is to check the understanding level of the basic concepts of the course in the assigned RoW-based research. Any diverted assumption in the students' reports can be a signal for an alert that one or a group of student have problem with the foundation. Once the rate of the alerting signal exceed a given major percent of the total class population, the alert signal returns towards the instructor's effectiveness. Self-evaluation using RoW is implicit and eventually efficient evaluation as students are not thinking that their activity is partly towards the evaluation of their teacher.

Summary of the lesson

Reinvention of the wheel (RoW) as a teaching style is introduced and briefly discussed. The following lesson learnt from this teaching style:

- It prepares the students for online learning, while they are in-seat learners.
- It inspires and enhances research attitude in students with possibility of inventing new approaches.
- The small size of technical writing, in the course of the student's degree can essentially enhance their technical communication skill that is one of the requirements of ABET.
- Long term practice on formatted writing.
- RoW-based learning turns the class from teacher-centered toward teacher and student-centered learning and self-learning where it has positive long-term effects.

- It encourages the academic integrity and ethics code among the students. It also works as a good practice for the student's future profession and engineering ethics.
- An implicit way of self-evaluation for the instructor.
- It helps students work with research tools and resources.
- Effective long term practice with office tools such as word processors, data analysis tools and graphical communication tools.

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