

Academic Frontier-based Approach Based on Constructivism

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Abstract: For the purpose of combination of the basic and academic frontier knowledge by the application of the theory of constructivist learning in order to trace the rapid development of microelectronics, Academic frontier-based approach (AFA) is presented. The learner-centered instructional approach is valuable for promoting active learning by involving learners in learning academic frontier topics in an open-ended and collaborative environment. The design and implementation enrich the teaching modes and the content of the key curriculums in depth. It is effective in achieving positive and higher cognitive goals.

1 INTRODUCTION

Many Universities have a growing concern with the learners' failure rates and academic achievement in engineering courses. Learners and instructors are often skeptical of the effectiveness of this technique. Some of the frequent complaints that we hear from our learners is "how to apply the knowledge in the textbook", "the lecture-centered study is inactively and bored", and we "have not shown them how to do." According to Shuell (Shuell, 1986), "If learners are to learn desired outcomes in a reasonably effective manner, then the lecturer's fundamental task is to get learners to engage in learning activities that are likely to result in their achieving those outcomes". John Dewey, the father of progressive education supports 'learning by doing'. Tyler (Tyler, 1949) wrote, 'Learning takes place through the active behavior of the learner; it is what he does that he learns, not what the teacher does.' Constructivist theories have being the common theory-in-use in higher education since the centrality of the learner is given. For instructors, how to inspire those young and fresh minds found in academia? How to develop the learners' curiosity in the subject they will face after stepping off campus?

We present Academic Frontier-based Approach (AFA) in the paper. The work reflects our on-going

research on teaching and learning in higher education in which we have developed in several of our engineering courses by learners' actively constructing new knowledge for the purpose of learners' academic pre-research and motivation.

2 WHAT IS ACADEMIC FRONTIER APPROACH?

Academic Frontier Approach (AFA) is a pedagogy that centers learner learning on Academic Frontier-driven projects facilitated by a instructor in order to achieve the new learning outcomes of courses related to the content in textbooks — expansive learning. Figure 1 gives the outline of AFA. It is a cognitive constructivist epistemology which concludes from science references that learners gain more through relating academic material and papers to their own interests and academic vision, and that such experience informs their ability to conceptualize content (Duffy and Jonassen, 1992). Constructivism calls for learning opportunities that are experiential, active, and collaborative. The goals here for the learner are: firstly, to develop and implement the new forms of teaching approach; secondly, cultivate the curiosity and motivation by expanding and collaborating learning in groups and

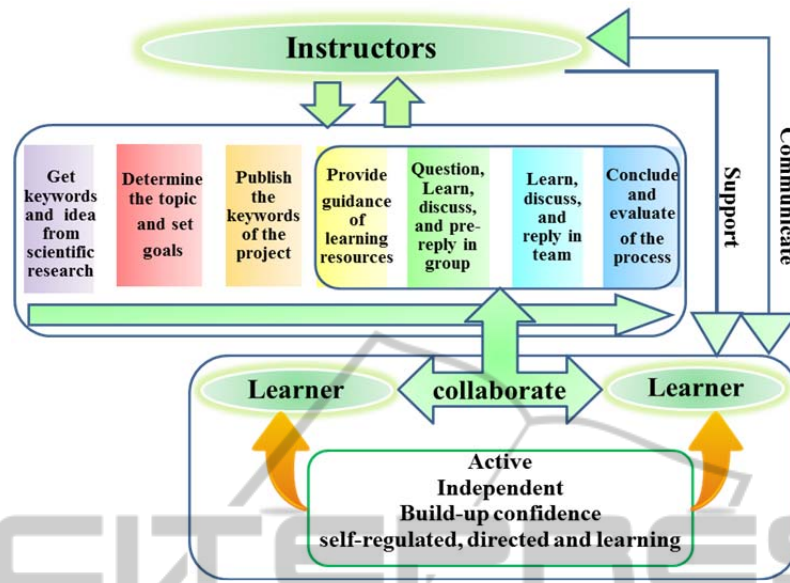


Figure 1: The outline of the academic frontier-based approach.

teams. Thus, it is not to passively absorb and regurgitate information; but rather to actively engage with the science references, through an inquisitional learning, discussing and analysis with group mates, and effectively review and get academic frontier knowledge with the corresponding basic knowledge gained in textbook. Therefore, the ultimate goal is the development of knowledge expanding, expansive learning, interest adding, and potential exploiting abilities which are beneficial for learner’s careers in the future research and work.

For our work, we have found several underlying themes to be particularly cogent toward our instructional activities. Specifically, AFA provides a context for the content of our courses; meaning that many of the individual concepts that each course identifies are drawn together to understand the new knowledge that are submitted to learners through the various keywords and topics that they work on during their AFA project work. It is important then to draw the distinction that AFA presents specific topics for learners to learn. The advantages of AFA project works in microelectronic courses are the increased engagement of learners and the relationship to professional practice, team cooperation and self-regulated and directed. Thus it is common to assign keywords and topics as a beginning for learners to illustrate their abilities of self-learning and reviewing of science references by group work, and indeed to assess that learning under

the guidance of instructors. The importance here is that we are not solely doing AFA project work, but also organize and construct advanced knowledge (expansive learning) based upon the well known content knowledge that has been written in textbooks. Such scaffolding is integral to the process as learners use the content provided along with their own learning with their groupmates/teammates, to construct new knowledge based upon the keywords and topics at academic frontier. Learners learnt in this manner would get an important experience in the process. Therefore, AFA and project-based learning (PBL) are similar in that there is a shared goal of successfully completing the activity in a learning community actively; however, it is different from the latter in that projects typically cultivate the abilities of review and analysis of references. Moreover, the implementation of AFA is a process of sharing information and goals, and improving social relationship by collaborative learning. Thus, AFA has the characteristics of PBL and collaborative/cooperative learning.

While AFA can be applied in any discipline, its appeal within microelectronic science is clear. The courses, such as “Semiconductor Physics”, “Physics of Semiconductor Devices” or “Compound Semiconductor Materials and Devices”, are courses designed to implement AFA. With the rapid advances within the microelectronic, it is also of particular concern that learners understand how to be

good independent learners that catch up with the progress of microelectronics. We will particularly value the pedagogy that results in graduates who are able to educate themselves about new technologies and conductor them AFA for their development in the future research and work. Thus, AFA directly supports the characteristics: an appreciation of the interplay between classic theories in textbooks and new knowledge at academic frontier, a familiarity with common themes and principles.

3 THE STRATEGIES AND PROCESS OF IMPLEMENTATION

3.1 The Constructive Strategy

- (1) About knowledge
 - To track the development of knowledge at scientific frontier related to textbooks.
 - To increase new content of teaching information and the depth of the topic out of the textbook.
- (2) About skills
 - To co-integrate knowledge.
 - To coordinate and grow up the teamwork of the learners.
 - To cultivate the learners' independent, active, communicative, self-regulated and directed skills by collaborating learning.

3.2 The Process of Implementation

- Inspiration. Instructors ask questions; provide the keywords and topics about academic frontier.
- Introduction. Instructors introduce the academic background and the main website of the references.
- Definition of goals and formation of community of learning. Instructors allocate the task to a team which is consisted of 5-10 small groups according to the scale of the class. The teaching aim is decided and the significance of the topics is explained.
- Instruction. Instructors guide the learners to learn online resources and track the development of the academic.
- Modification of sub-goals. Learners learn, ask question, read, analyze, discuss and review by themselves and cooperate with the group-mates

by QQ group and face-to face discussion in group meeting. Each group gives the presentation of the sub-goal.

- Integration of goals. The team gives the final presentation by integrating the key contents from each groups and discussion in class.
- Evaluation of the process by instructors.

4 CONCLUSIONS

To sum up, the AFA to teaching and learning has the characteristics as follows: The integration of knowledge of academic frontier and the essentiality of study; the exploration and the target guidance; the fun of teaching, the extensibility of teaching and effectiveness; construction; the cumulativeness of the study; the diagnosis and the rethinking of learning; the society and collaboration.

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