Work in Progress - Using the Kolbe Conative Index™ for Improving Retention of Computer Science Students

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Abstract **- A large number of students who begin the computer science program at California State University, Northridge never finish. Although many students who leave the computer science program eventually graduate in other fields, the high number of drop outs is of concern. Previous studies have shown that computer science students nearing graduation tend to have common characteristics as measured by the Kolbe A™ index. These studies also indicate that changes in instructional techniques could have positive effects with respect to retention. The position here is that many students who could benefit from the Computer Science program, and who could in turn benefit the field, are being discouraged from continuing. In the current study, the Kolbe results of all students entering the computer science program will be used to suggest improvements in advisement and recommend changes in the learning environment to improve student retention.**

Index Terms - Active Learning, Advisement, Conation, Student retention

INTRODUCTION

Sadly, it is the case that the overall graduation rate (defined as the percentage of incoming freshmen that graduate within six years) at California State University, Northridge (CSUN) is among the lowest in the state, and perhaps in the nation. In the department of Computer Science the situation is even worse. Of the more than 200 students who decide to major in computer science each year, fewer than 40 typically complete the program. Although many of these students eventually graduate in other fields, the high number leaving the computer science program is of concern.

The high dropout rate among computer science students is not unique to CSUN. Even among universities with excellent overall graduation success, computer science retention rates are poor. For example, the University of Waterloo reports an average graduation rate of 73.7%, but the computer science rate is only 58.1%, the lowest of all reported programs [1]. Improvement in computer science retention requires understanding why so many students leave the program.

One possible explanation is that many students decide to major in computer science without really knowing much about the field and whether it is a good match for their interests and abilities. Only after taking some initial courses do they find that their talents and interests lie elsewhere. A 1998 report from the University of Canterbury on pre-university issues [2] discusses the fact that students entering the university often seem to have an incorrect perception regarding the nature of computer science. Although there was disagreement about what that perception was, they concluded "we must work harder to make [K-12] school students more aware of the nature of our subject." Even without such increased awareness among entering students, better advisement of incoming freshmen could also help address this problem.

There is, however, significant evidence suggesting that other factors also contribute to the high drop out rate. The wide diversity of preparedness among students entering the program is often cited as a problem. In many cases early courses in the program are directed at the well-prepared students, ignoring the needs of those with little prior background in the field. Many of these less prepared students are women and economically disadvantaged students whose pre-university experience did not include computer use. It might be possible to improve retention through improvements in the way the subject is taught. At Loughborough University, a report documented a correlation between improvements in teaching and a reduction in the dropout rate. [3]

Previous studies at CSUN, using the Kolbe A™ index, have suggested a relationship between students' natural ways of doing things, like problem solving, and success in the computer science program. These studies further indicate that changes in instructional techniques could have positive effects with respect to both student achievement and retention.

BACKGROUND

In one previous study [4], it was shown that computer science students nearing graduation tend to have some common characteristics as measured by the Kolbe A™ Index. [5] The Kolbe instrument measures conation, or a person's inherent talent or natural way of doing things and predicts what a person will or will not do, given the freedom to act. There appears to be a relationship between high "fact finder" and "follow thru" Kolbe characteristics and student success in the computer science program.

The Kolbe characteristics indicate a student's natural modes of operation. The "fact finder" will collect data, establish priorities, define goals, gather information, and evaluate options while the "follow thru" individual will seek order, structure, design systems, make lists, and will chart progress and worst case scenarios. One who operates in "fact finder" mode will focus on details and engage in research. One operating in "follow thru" mode will develop procedures and seek a sense of order. A "quick start" individual," one of the other Kolbe characteristics, however, will experiment, take risks and seek open-ended solutions.

The implications of this for teaching are that typical computer science students are very comfortable with the traditional lecture mode of instruction where they are able to gather information and have time to analyze it before acting on it. In many active learning approaches used today, students are asked to interact with others in the class or the instructor in an ad hoc manner, trying to find solutions to problems without a prior analysis of pertinent information. This experimental, open-ended approach to learning and problem solving is much more consistent with the "quick start" mode of operation. The final mode identified by Kolbe is "implementor". One who operates in this mode uses space and materials, and builds, constructs, and uses hands on equipment with ease. Although everyone has the ability to operate in any mode, people are most productive and comfortable when they are able to utilize their strongest conative talents.

Not too surprisingly, most computer science instructors have Kolbe profiles that are almost identical to those of the typically successful students. That probably explains why very little active learning is done in computer science classes, and may indicate why some students (those without typical Kolbe profiles) may not feel that computer science is the right field for them. It may not be the material that is taught that discourages them, but rather the manner in which it is taught.

It is also interesting to note that women seem to have a much greater preference for active learning than do men. In another study done recently at CSUN [6], computer science graduates from the last five years were surveyed regarding their experiences and feelings about active learning. The results showed a statistically significant difference in attitude between female and male students toward active learning, with women rating all group activities and the preparation and presentation of projects significantly more valuable than men.

OBJECTIVES OF THE CURRENT RESEARCH

Although some might argue that the high dropout rate among computer science majors is not a problem, that only students who don't really belong in the program are being eliminated, the position here is that many students who could benefit from the program and who could in turn benefit the field are being discouraged from continuing. As stated in the article by Sorensen on women and computer science [7], there are losses to society "when the scientific and technological talents and experiences of women are not utilised" The same might be said for many other students who leave the program because it fails to accommodate their natural way of learning.

In fact, based on the results from a study on teamwork in software engineering [8] the most productive teams are those with synergy, or a balance of Kolbe talents. When a team is composed of like Kolbe characteristics, inertia develops. If a team is composed of too many "fact finders" and "follow thru" individuals, "analysis paralysis" will set in, as members spend endless hours probing, questioning, researching, and organizing. A shortage of "quick start" and "implementor" talents, the other two Kolbe modes of operation, makes forming synergistic teams difficult. This is a problem not only in the classroom but within the software industry as well. It would be a great benefit to the field if universities could produce computer science graduates with these other Kolbe talents. The goal of this research is to encourage students of varying conative talents to enter and continue in the field of computer science by engaging them more in the types of problem solving in which they thrive.

CURRENT RESEARCH APPROACH

The current research is focused on utilizing the Kolbe index to determine the conative talents of students entering the computer science program. We expect the results will show that the entering student population is much more conatively diverse than students successfully completing the program. Such a result will support our hypothesis that many students leave the major because the typical mode of instruction is incompatible with how they best learn. Recommendations will be developed for modifying instructional strategies to improve the retention of a student population with more diverse approaches to learning. Additionally, suggestions will be made for using individual Kolbe results to improve the advisement process for students contemplating a major in computer science.

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