The First Two Years:
Addressing the Goals and Content of Mathematics

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Webster defines a circle as 1) a plane curve everywhere equidistant from a given fixed point, the center and 2) a series or process that finishes at its starting point or continuously repeats itself [1]. To take a look at the major issue and future direction of undergraduate mathematics as it relates directly to the goals and content of the first two years, we may consider the above definitions. It is imperative that we decide how large the circle should be, if in fact the size has changed over the years, i.e. did the diameter increase allowing room for more and how are the choices made to increase the amount of content. More specifically to address these issues the Interdisciplinary Workshop on Core Mathematics at the United States Military Academy, November 4 – 7, 1999 focused time and energy on the issues of content choices, goals and the intended audience, presentation of materials to include modeling and application, the achievement of high standards and the timing of offering identified courses or content. In particular the conference focused on the first two years of student higher education training. Discussions implied that the circle would not necessarily change. Students have the ability to transfer and expand knowledge if they have a solid mathematics foundation. The existing content itself is necessary in producing successful students.

As we enter the next millenium many new challenges will face the learner and the presenter. The questions to answer relative to "goals and content" of the mathematics core are 1) What prerequisites do we expect the learner to have when they enter these courses, 2) What content is necessary to pursue the identified careers requiring what we have labeled "Calculus", and 3) What type of instruction will allow these students to gain and retain the most as they exit the course and/or involve themselves in many interdisciplinary focuses.

Currently the major topics covered in the first two courses of traditional calculus extend from "limits" to "application of integration". I believe that our task is not to eliminate the existing content in the circle but to decide on the depth and presentation of the material. For more than ten years calculus reform projects have focused on process and not content. It is believed that if a student understands basic concepts and essential definitions with the use of technology they are able to explore and transfer that required knowledge. Bradley and Smith in their recently published Calculus textbook state that "precise reasoning has been and they believe will continue to be the backbone of good mathematics"[2]. For many mathematicians it has been a reeducation to believe that every theorem does not have to be proved and that the student will survive. Students that receive strong foundations at the entry level to include problem solving skills will be able to ingest and apply a wide variety of information.

As one evaluates the inclusion of selected content the question of theoretical balance will evolve. The choice of theory inclusion for the reformist is broad. A review of Calculus by Ostebe/Zorn shows that much theory is included in their Reform Calculus. On the other hand "The Harvard Consortium" believes that indeed the point of mathematics needs to be established but the level of theory is significantly less [3].

It is important to “know your students”. To succeed in being effective, the instructor must poll their students on the first day of class unless the information is furnished through pre-registration. It is important that instructors know their audience and circles. Decisions can be made to determine if the circle needs to be expanded or if the appropriate foundation exist that will allow the student to move forward. This allows the instructor to select the most appropriate modeling and application exercises. It also allows interdisciplinary opportunities for faculty. If true interdisciplinary applications are utilized students should benefit in both areas and the “Why am I taking this course?” should be fully understood. It is our responsibility as faculty that students understand the why and how of these courses. Why are they needed for my major and how can I apply them to other courses in my curriculum. It is therefore apparent that the interdisciplinary approach needs to be widespread and respected. Students should not have to accept that they are simply taking calculus because it is required but understand that it is the fuel that makes the other disciplines run. Application and modeling exercises help to assure the students of the needs and importance of mathematics.

If appropriate goals are established, then high standards can be established. High standards are achievement levels set to be obtained by the students enrolled in the identified courses. These standards are based on a number of observations related to the goals of the course. In the traditional sense high standards have been measured by a culminating test or exam which requires a student to regurgitate what has been presented to them. The reformist interprets high standards to be the ability to apply knowledge and engage themselves in “what if “ questions. High standards may be measured by written and oral communications and observations. Additionally students begin to set high standards for themselves when they realize the relevance of the mathematics to their own disciplines.

Once the issues of content choices, matching goals to the intended audiences, presentation, and the achievement of high standards has been addressed then it becomes necessary to establish the most appropriate time to offer the courses. The decision to offer Calculus will not be the same for all students or institutions. When Calculus should be taught again will depend on the prerequisites a student has upon entering each program. How much of the circle have they been exposed to and the other contents of their circle will be important. Some students ere completing one year of calculus in high school. However there are many capable students for whatever reason have not been exposed to the subject before entering the college walls. This means that it is imperative that all students have the adequate preparation before beginning the calculus sequence. It the calculus is taught in the first year it allows for increased modeling and interdisciplinary application activities. In addition to the calculus sequence, students in the science and engineering fields may identify a need for discrete mathematics, linear algebra, differential equations and probability and statistics.

The circle has not changed over the period of time. What we utilize in that circle may differ from one audience to another. For instance the chemist, engineer and physicist may have different mathematical need levels. We supply each of them with the knowledge that will allow them to move forward in their discipline and extend what they have learned. The presentation of the material may be different however each approach provides a window of opportunity to continue the learning process. Hopefully the inclusion of technology, small group projects and interdisciplinary assignments will help in our effort to produce the very best mathematically prepared students in the new millenium.

References:

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