The Education of Women in Mathematics

Of the freedoms granted to citizens in the United States, one of the most overlooked is the freedom of education. Especially neglected is rather recent freedom of education for women. Prior to the American Revolution, girls were rarely permitted to be educated in the traditional sense with their male peers; rather, their education of household duties was seen as more imperative than that of the sciences and languages. In fact, girls were rarely taught more than simple arithmetic, since, “arithmetic was necessary for commerce and bookkeeping; no women...had need of this skill in an era of subsistence agriculture and limited trade” [5, p. 76]. However, shortly following the Revolutionary War it was thought important to educate girls and women in the area of mathematics in order to have them aid in the functioning of family businesses.

Before examining the developments that led to granting women the education in mathematics available today, first it is necessary to detail a few developments that occurred in education as a whole following the Revolutionary War. Education reformers, in the late 1800s established arguments for advancing female education in terms of a woman’s social role, which included being wife, teacher, and mother. “The education of women was crucial to the welfare of the state because the primary duties of motherhood included ‘the education for time and eternity of the next generation of immortal beings’” [5, p. 130]. Also, the education of women was crucial, since women made the best teachers for the elementary education of children. While certain advocates desired to maintain the traditional system of education, others believed that a woman needed the same discipline as a man, and thus should be instructed in the sciences rather than “the merely ornamental branches of drawing, painting, and needlework” [5, p. 131]. They believed that science “could serve the same function by training students to observe critically and think logically” [idem]. This movement not only furthered the education of girls, but also enabled boys to experience higher levels of the sciences. Furthermore, while boys were required to learn both the classics and the sciences, educational curriculum geared towards female students was to remain purely scientific.

Dame schools were the first institutions to educate women in the field of mathematics. These schools were primarily run by a woman in her home or in a primary school with little public support. Both boys and girls were permitted admittance into the dame schools; the boys were prepared with instruction in English to enable them admittance into grammar schools, while girls were taught the simple subjects of the alphabet, spelling, reading, writing and numbers, and, “to these basic subjects were added knitting and sewing for the benefit of female students” [5, p. 76]. Private schools or tutors also enabled girls to be educated in the area of mathematics, including arithmetic, algebra, geometry, trigonometry, and surveying. Though most tutors catered to boys, some were willing to expand their expertise to girls by adapting their lessons toward the female sex, “so as to render them concise and familiar” [5, p. 77]. Many wealthy families enlisted their son’s tutors to also instruct their daughters in mathematics, though many did so only with an increase in wages.

Following the Revolution, the mathematics education for women was not only a fairly modern notion, but it was also quite controversial. While knowledge of arithmetic was viewed as a fair characteristic, the learning of advanced mathematics, algebra, geometry, trigonometry, and calculus, was seen as a sort of taboo. In other words, the education of girls in the areas of addition, subtraction, multiplication, and division was seen as acceptable, but a girl receiving any information that exceeded those grounds was unforgivable [5, p. 78]. Not only were these areas
of mathematics viewed as concepts only boys could master, they were also seen as too difficult for girls to understand. However, women’s education advocates declared that the study of mathematics would not only promote mental discipline, but also develop the female mind. However, dissenters to this idea argued that, in the early 1800s, women teaching in primary schools, though dependent on a substantial education, were without the need to increase their mathematics abilities, since the curriculum of the schools rarely reached farther than the standards of arithmetic. Moreover, since higher mathematics was required for the generally male-driven careers of surveying, navigation, and the military, it was argued that women were in no need of an advanced mathematics education [5, p. 79]. These areas of study held little importance or relevance to a woman’s work in the home, so it was seen as a superfluous deed to educate the nation’s female youth in bounds greater than arithmetic. Furthermore, the areas of algebra and geometry were rarely necessary for advancement from grammar schools to colleges in the United States in the early nineteenth century. Since institutions of higher learning were closed to women in those times, it was seen as excessive to educate women in a field where they would never succeed.

The movement to instate higher mathematics in the education of women can be credited to well known educator Emma Willard (1787-1870). Primarily self-educated in mathematics, Willard began studying geometry after opening her first grammar school for girls in Middlebury, Connecticut. She told her nephew, “I have gone through twenty-nine propositions of the first book of Euclid. I am delighted with the study, and I see no insurmountable difficulties.” [5, p. 80]. This small passage held much significance at the time; if a self-taught woman was able to conquer Euclidian geometry, imagine what a student, of either sex, would be able to accomplish with the aid of a well-educated instructor. With the new knowledge in mind, and the determination to transcend the traditional views of mathematics education in her heart, Willard opened an all girls’ school in Waterford, New York, where she began teaching geometry to her students. This move shocked the local community, and with the successful examination of her first student, caused the locals to proclaim that her work was more memorization than skill, and that, “no woman ever did, or ever could, understand geometry” [5, p. 80]. Determined to expand her mathematical knowledge as much as possible, Willard next began to study algebra, which she would dispense to her students soon after conquering the information herself.

Determined to expand this education to all women, Willard left Waterford and moved to Troy, New York, where she opened a seminary to instruct female teachers in the area of mathematics [5, p. 80]. Willard desired to educate more women in the field of mathematics not only to introduce women to this science, but also to save money and conserve the insecurities of her female students. Not only would female teachers work at lower wages, but they were also more compassionate to the needs of girl students, who were historically believed to have “no mathematical aptitude” [5, p. 80]. Willard’s methods on instruction were passed on through the community through the writings of several mathematical texts that were compiled by her sister, Almira Hart Lincoln Phelps.

The education of mathematics to women in the United States can be traced to the migration of Troy graduates into other schools nationwide. While many girls’ schools did not have mathematics in their curriculums, it was common to implement courses in geometry and algebra after a graduate from Troy joined the teaching staff at school [5, p. 81]. For example, after the opening of the Phillip’s Female Seminary in Chapel Hill, by a Mrs. Phillips and a Troy graduate, the mathematical curriculum included arithmetic and Euclidian geometry [Idem]. By the 1820s, algebra and plane geometry had found a place in the curriculum of 162 girls’ schools.
in the United States [7, p. 418]. Comparably, 81% of girls’ schools offered curricula in advanced mathematics during the period 1750-1840, while only 63% of boys’ schools offered similar curriculums [3, p. 428]. While the female institutions focused primarily on the education of algebra and geometry, the male schools also offered courses in surveying and navigation, two occupations dominated by men. The drive to offer more mathematics courses to women was supported mainly by the necessity to educate women to ensure quality teachers for grammar and high schools.

Many cities did not promote the secondary education for boys, as the majority of boys would leave school to search for jobs in the work force. For these reasons, many major cities did little to finance the education for boys. For example, in Boston, Massachusetts, in 1826, a girls’ high school was opened to “promote their moral and intellectual development, to better prepare them for marriage and motherhood, and to train teachers for the city’s primary schools” [5, p. 85]. At the same time, the boys’ high school was losing enrollment because parents were finding apprenticeships for their boys and thus discontinuing their enrollment in schools. With these two issues in mind, it is clear to see that girls finishing high school would receive a higher mathematics education than their male counterparts; since the girls continued their education until graduation, they had the opportunity to experience higher mathematics.

As previously stated, one of the greatest contributing factors to the education of mathematics to girls was to ensure that they were capable teachers. In fact, “young women teachers without the necessary mathematics training often found themselves in less demand than those who could teach geometry and algebra” [5, p. 87]. It was not enough that a woman finished high school to ensure that she received employment as a teacher; she had to be educated in advanced mathematics in order to compete in this growing field of women educators. This demand for well-educated female teachers caused the increase of female institutions that included higher mathematics study. Even in coeducational schools, the mathematics achievement of girls tended to exceed their male classmates. Not only did this access to mathematical knowledge allow girls to become mathematics teachers, but it also opened the doors for the study of other sciences. Since chemistry and natural philosophy required knowledge of algebra and geometry, girls were not limited to learning the basic subject of reading and writing anymore [5, p. 89].

By the 1910s, women had finally gained admittance into education at the collegiate level. Due to the demand for teachers at the secondary level, women were now striving to achieve a mathematics education at the undergraduate and graduate levels. High schools were requiring more of their students, and the teachers needed to be educated in the fields in order to adequately present that information to their students. At Stanford University in California, in 1932, forty mathematics degrees were awarded to women, a percentage that was three times the percentage of female students enrolled in the university [1, p. 497]. Likewise, in 1907, at the University of California Berkeley, fifteen of the eighteen degrees in mathematics were awarded to women, and in 1911 women attained all nine degrees. In the same year, two of the three masters degrees in mathematics were awarded to women [5, p. 91]. The first doctoral degree in mathematics granted to a woman was in 1886, to Winifred Edgerton, and since then thousands of women have achieved the highest education possible in mathematics [4, p. 1].

After the American Revolution the United States faced an era of rebuilding and growth. One area that faced substantial development was the education of women, especially in the area of mathematics. Now, women were not solely expected to remain in the home and tend to domestic responsibilities; rather, they were now able to expand their lives to the classroom, to
learn and to teach. “Schooling for adolescent girls was no longer a matter of a luxury of accomplishments for the daughters of the rich, but the avenue into a productive role for middle class women outside the home, a role which...did not conflict with traditional ideas of the character of women” [2, p. 139]. Women were viewed as the most capable of the sexes to undertake the responsibilities of teaching the young, and especially in the education of girls. The young women would grow under the instruction of teachers, grasping the knowledge presented to them, and branch out to teach other girls the mathematics that they deserved to know. While the mathematics education of women began as a means of educating teachers, it has grown into a system of higher education that more women than men take advantage of. Without the work of dedicated young women such as Emma Willard, the mathematics curricula that are implemented around the nation would have developed at a substantially slower rate, and women would have suffered from such an occurrence.

Sources:


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