Student calculator use the need for limitations education essay

Math is an integral part of life. Humans cannot go through life without using math in some shape or form, whether it is counting money to pay the dinner bill, adding up the amount of money collected in a fundraiser or calculating advance equations as a nuclear engineer. Calculators have also become an integral part of life. Calculator use in schools has been a basis for debate for almost forty years. Calculators can benefit or serve as crutches for society. They prove beneficial in speeding up calculations when paying bills and taking tests. However, they can also be a hindrance. People often become so dependent on calculators that they begin to lose the ability to perform simple mathematical equations such as fifteen times three equals forty-five. Students are affected by calculator use to a higher degree than anyone else because they are in classes where they are required to calculate, problem solve, and analyze every day. Calculators can be helpful; however, the use of calculators, by students in all grades, should be limited. Overuse of calculators often leads to student loss of confidence in mathematical skills and abilities, a misunderstanding of the role and function of the calculator, and overdependence on calculators as tools only.

Many students and adults, including teachers, believe extensive use of calculators should be a requirement in mathematics classes. Several states, including North Carolina, now require the use of graphing calculators in the curriculum and on state tests while others allow, but do not require calculator use. Dion et al. showed that over “...95% of schools surveyed allowed or required calculators in their Algebra I classes, 98% allowed or required calculators in their Geometry classes, 99% allowed or required calculators in Algebra II and 99. 9% allowed or required calculators in their

Pre-Calculus/Trigonometry classes" (429). Many teachers allow students to have unlimited use of calculators in their classrooms and believe that student calculator use makes learning mathematics more interesting to students (Brown et al. 106). These facts reflect the views of many regarding the need for consistent calculator use in the classroom, however, the debate rages on.

Even though many students, teachers and parents argue that there should be calculator use in the classroom, they agree that use should be limited to some extent. What they do not know, is where to draw the line. The constant use of calculators present many potential problems in learning experiences, including but not limited to dependence, overuse, and the process of pushing buttons rather than performing mathematical computations. Most educators concede that calculator use should be accompanied by instruction, modeling and practice. As a future mathematics teacher, I consider calculators to be effective when introduced and implemented properly in the classroom. A combination of instruction with calculator use promotes more effective and efficient applications of mathematical strategies and procedures by students.

Ineke Imbo et al. researched different math problems and individuals to see how elements like problem size, operations, gender, practice, skill, and calculator use influence simple arithmetic performance. It was found that " procedural strategies were performed faster when problem size was smaller, arithmetic skill was higher, and calculator use was less frequent (Imbo et al. 458). This substantiates the need for limiting the use of calculators by students. Subjects in the research of Imbo et al. were studied in terms of choosing and executing retrieval (what is known) and procedural (the

process of working problems out) strategies on an arithmetic skills task, test, and questionnaire. “ Students who used calculators frequently showed low retrieval and procedural efficiency level but did not differ in strategy selections (Imbo et al. 459). The results showed that students often selected good strategies for problem solving but the choice of strategy did not always produce effective or efficient procedures or processes for solving problems, and the number of procedures identified in doing math is limited by calculator use. Imbo et al. related frequent calculator use to poor arithmetic performance for both young children and adults in this research (460). This poor arithmetic performance, enhanced by frequent calculator use, often prefaces mathematically related confidence issues in students.

Many students struggle with math and develop a dislike for it because they lack confidence in their mathematical skills. Unlimited use of calculators frequently helps build a feeling of inadequacy or give students a false sense of confidence (Porchea 118). Calculators are not meant to, and cannot, solve all math problems in classrooms despite the fact that many people think so. Dion et al. reported in her studies that “ few items on the teachers’ exams actually required calculators to solve” the problems (433). Since tests do not reflect the need for calculator use, it is degrading to assume students need calculators in order to perform mathematical operations. This abasement of ability lessens the confidence levels of students in mathematical operations. Lack of confidence mathematically is compounded by confidence issues in performing calculations with calculators.

Research also shows that students are often uncomfortable using calculators. Berry and Graham analyzed students’ keystrokes on calculators

as they took tests (143). They found that students did not “ create schemes or ways of working that incorporated the calculator” (Berry and Graham 143). Even though there were problems on the tests that required certain types of calculations within the ability of the calculator, key stroke analysis showed “ virtually no evidence of these being done on the graphics calculators” (Berry and Graham 143). When students were interviewed and asked about this they replied that “ while they knew how to use the calculator to carry out statistical tests, they did not feel totally confident in doing this” (Berry and Graham 143). Berry and Graham’s research discloses that students who lack calculator knowledge, abilities and confidence lack the same in regards to math. This has many implications for teachers.

Porchea’s study indicated that teachers spent an abundance of time reassuring students on their use of calculators and providing detailed explanation concerning students’ completed tasks on the calculator (50). Quesada studied seven hundred and seventy students in college pre-calculus classes (206). The control group study required the use of scientific calculators and a regular math book. The experimental group used one type of graphing calculator and a textbook designed for graphing calculators. The experimental group scored higher on the final exam than the control group. Results of the study argued that the use of the graphing calculator and designed textbook facilitated understanding, provided ability to check answers, and saved time. However, the students that used graphing calculators performed slightly worse in the class than in previous math classes (Quesada 212). Students voiced that they were concerned that while there were advantages to graphic calculator use, they did not feel prepared

for the next level math course and sensed they were too dependent on the use of calculators in class. This demonstrates students' lack of confidence in calculator applications and their abilities to compute mathematical problems, even when receiving instruction on calculator use and integration of calculator skills in classes. Students must learn to use calculators to the fullest extent to benefit from the technology. The Theory of Instrumentation, introduced by Berry and Graham, discusses calculators as tools or instruments (141). If, when using a calculator, students incorporate techniques to solve problems the calculator becomes a tool utilized to complete a task. When a " scheme" or plan is constructed by students while using the calculator, it evolves into an instrument (Berry and Graham 1044). The difference between students using a calculator as an instrument or tool shows whether they understand the capabilities of the calculator. They use this knowledge to plan and strategize a solution to a problem (instrument use) or they may be calculator smart and know all of the right buttons to push to get an answer (use as a tool). When students are using the calculator as an instrument they are creating a solution to a problem. Students often view calculator actions to be completely separate from mathematical computation and problem solving. Most students use calculators as tools. Teachers should expect and demand calculator use as an instrument in their classrooms. When calculators are used as instruments, students demonstrate knowledge of how the calculator works and what it can do.

Berry and Graham studied twelve students as they worked on a set of two tasks and found, through their keystrokes, " that the students were too

reliant on the calculator without knowing many of the anomalies it may induce" (146). No scheme or plan was evidenced by their keystrokes, because the students did not create ways of working that incorporated the use of the calculator as an instrument (Berry and Graham 142). Students utilized the calculator as a tool to find an answer, not as an instrument to devise a plan to solve a problem. In Berry and Graham's studies, use of the calculators as tools impacted the students, but unfortunately student knowledge and understanding never impacted how the calculators were used (142). Data from McCulloch provides evidence that many students perceive the graphing calculator to be a " tool that is important because of its ability to lessen the thinking involved in solving a problem" (43), and they also consider calculators to be efficient tools in solving problems quickly (McCulloch 87). The use of a calculator offers students a variety of powerful new learning and problem solving strategies, but as a tool, it diminishes the need for the student to acquire a high degree of skill in symbol manipulation (Katsberg and Leatham 29). Students must be knowledgeable about calculators to use them as instruments to find ways to solve mathematical problems.

Whether calculators are used by students as tools or instruments, they are only as smart as their users and can only perform operations when manipulated to do so. Therefore, students must understand the role and functions of the calculators to use them effectively and efficiently. The lack of knowledge about the functions and problem-solving techniques of calculators often results in student misuse and errors. While students know the basic processes of calculators, they are not aware of the special

functions, keys, and features calculators have, or the role of these in the use of the calculator to solve problems. Students seldom go beyond the functionality of the calculator to explore the potential or constraints of the technology. Berry and Graham revealed that students in their case studies were unaware of many of the features of the calculators even though they had access to and used calculators every day in class. The students also made mistakes that would not have been made without the use of a calculator. The advanced operations of calculators, such as screen size and trigonometric functions, were never explored by the subjects in the studies of Katsberg and Leathman (27). For example, the students were required to graph a function and because they did not know to change the screen size of the calculator they graphed the wrong function as their answer. They knew what the function should look like but because the calculator showed them differently, they assumed the calculator was correct. If they had a working knowledge of the functions of the calculator, the students would have known to change the screen size. If they would have graphed the function by hand, they would have realized their mistake. In Katsberg and Leathman's research, graphing calculators were found to be used predominately to check algebraic solutions, find solutions graphically, and to graph functions. When students understand the role and functions of calculators, they are comfortable using strategy and applications to solve mathematical problems.

Katsberg and Leatham's research also indicates that students become confused and overwhelmed as they attempt to integrate their knowledge of mathematics with their developing understanding and use of a calculator (28). Brown et al. indicated through their research that teachers of high

mathematics courses worry that calculator use by students may be a way of getting answers without understanding mathematical processes (102). The majority of the time students do not use previous knowledge to solve problems using the calculator. “ When using a graphic calculator the students seemed to have forgotten what they learned when they first started out plotting graphs” (Berry and Graham 146). There is a wide scale difference in the ability to solve a problem using a calculator and the application of knowledge and skill to solve mathematical problems through critical thinking and calculator applications.

Berry and Graham found, through the keystroke research, that students often adopted a button pressing experimental strategy to solve problems instead of understanding the process (147). Dion et al. reinforced this by concluding that “ The introduction of calculators into the curriculum necessarily invites students to learn keystroke rather than concepts” (433). It is important to distinguish between calculator proficiency and the mathematical ability of students. The need for students to regularly write down their work and reflect, rather than just get the answer to a problem, stems from this lack of student understanding in what a calculator can do and how it is used. Quesada et al. observed that students tend to automatically begin to try to graphically solve problems instead of solving them algebraically when calculator use is allowed in classes (213). Students who were interviewed in McCulloch’s case studies indicated that “ calculator use is a security net kind of thing” providing a chance to plug- in numbers to find answers when needed (2). What follows is a false sense of security regarding mathematical abilities and skills. Calculator use does not ensure

that a student is mathematically proficient just like the ability to do math does not indicate strength in calculator skills

My experience going through school supports my argument that calculator use in schools should be limited. Throughout my middle school years we were allowed to use a TI-15 brand calculator. Slightly more advanced than a scientific calculator, it allows for computing and simplifying fractions and using percent signs. We rarely used them in class or on homework assignments. Due to the limited use of the calculators in middle school, my Algebra I class during my freshman year of high school was a breeze. However, as a tenth grade high school student, TI-83 calculators were required. TI-83's, available in every classroom, were used every day from that point forward in my high school career. Access to a calculator at all times, fostered a dependence on using it for a good amount of the work I did. When I arrived at North Carolina State University I was shocked that I was not allowed to use a calculator in my math classes. During my Calculus I class last semester, calculator use was not allowed in class at all, for any reason. Limited calculator use has continued this semester in my Calculus II class. I often find myself having to re-study certain aspects of mathematics because I became so dependent on my calculator in high school. It was, and is not, an easy thing to do. College math professors move through material quickly and provide little review time in class. More research should be done to accurately present how calculator use in schools is affecting students, individually and as a whole, from the time of transition from middle school to high school and through graduation from high school.

Calculator use should be limited due to the many problems students face when using them. Even with the North Carolina Department of Public Instruction’s mandate of calculator use in the classrooms, limited use could be easily implemented. Teachers could assign calculator inactive homework and force students to show all of their work. Another option would be to make assigned tests calculator inactive but allow time for students to use the calculator to check their work once they have finished the test. Students might also be required to show all of their work on tests and quizzes with the calculator available to them for use. Limitations could be set on calculator use by not allowing the calculators when students are learning new material. Checking work with the calculator after quizzes, where calculator use is prohibited, might provide a great teaching moment as students begin to learn how they can check their work or perform these tasks accurately on the calculator while reflecting on the completed work.

The use of a calculator can cause negative effects, but is not usually harmful until students become dependent and think they cannot accomplish mathematical tasks and tests without them. If teachers do not require students to show their work regularly, then they cannot claim mastery of skills in mathematics. Also, teachers cannot expect their students to claim mastery of mathematical skills. With the limitations above, or if teachers design their own creative limitations, the students’ mathematical ability will be even greater than what it is currently. It cannot hurt to limit the use of calculators; it will simply help improve college-bound students’ skills as they enter college. It will also increase the knowledge and mathematical skills and abilities of those who are graduating and going into the military or workforce.

This would better promote the goals of high schools, to prepare and educate skilled, globally aware, and “ future ready” students for tomorrow. Calculator use in schools should be limited to better ensure that students possess mastery of skills without dependence on sources other than themselves in preparation for the present and future.