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ARTICLES

M³: Leroy Raadel Posey, an African American Inventor of a Mathematics Teaching Machine

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Abstract

Evidence of African American cultural ingenuity can be found throughout history. This article chronicles the extraordinary story of Leroy Raadel Posey, an African American inventor of a mathematics teaching machine—the Combination Slide Board. Through a historical examination of primary source documents, the man behind the machine is revealed as a mathematics educator whose life's work focused on providing access to the mysteries behind mathematics. The patent details the purpose of the Combination Slide Board as a teaching machine and calculating device. An examination of Posey's research and publications exposes his innovations in the emerging field of mathematics education. This analysis reveals the journey of the man, machine, and mathematics (M³) and the creation of the Combination Slide Board as a twentieth-century teaching machine.

Keywords Mathematics · Educational technology · Teaching machine · Educational device

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The depth of African American technological ingenuity remains an anomaly to the world. Folks continue to be amazed by African contributions to Science, Technology, Engineering and Mathematics in particular. This always seems a bit odd as the evidence is there but must be revealed by scholars.

The man, machine, and mathematics = M^3 is the story of Leroy Raadel Posey (1818–1971), a little known African American inventor of an educational teaching machine. The history of teaching machines excludes the contributions of African Americans in particular and people of color in general. Teaching machines were characterized as "constructed educational devices for individual self-instruction" that had "important implications for educational practice" (Lumsdaine 1960, p. 5). These machines delivered programmed instruction in content areas such as spelling, reading, or mathematics. Some principles of programmed instruction delivered subject matter in small units, required students to respond, conveyed immediate feedback to the student, and promoted self-paced learning (Fry 1963). The importance of this history is that the programmed instruction evident through early teaching machines served as the theory and practice to computer-assisted instruction (Kay et al. 1968).

This article examines the man, machine, and mathematics surrounding Posey's invention of the Combination Slide Board in 1940—an educational device for

mathematics instruction on the elementary level. Posey's patented invention serves as a historical marker to the histories of educational technology, instructional design, and mathematics education. Although it was once lost, this important contribution to history is now found.

This article seeks to answer the following questions: The Man: Who was the man behind the machine? The Machine: What drove Posey to patent and build a teaching machine in 1940? Could the Combination Slide Board invention teach mathematics, and thereby be classified as a teaching machine? The Mathematics: What knowledge about mathematics instruction did Posey feel he could contribute to the education of black youth in general and the world more broadly?

In order to examine the man, machine, and mathematics, this article relies heavily on primary source documents and an interpretation of these sources. Secondary source documents were limited to the historical context surrounding this examination. Posey did not achieve the accolades of written history; however, he was an ordinary man who achieved something extraordinary.

Posey–The Man
Tell me not in terms of numbers
Math is but an empty dream;
For the soul is dumb that slumbers,
Problems are not what they seem.
Math is real! Math is sound!
Flunking you is not its goal.
Abstract thinking is renown,
For the alert ambitious soul.
Not enjoyment, and not hate,
Is its destined end or way;
But to act before too late,
Gaining knowledge day by day… (Posey 1948, p. 245)

The Psalm of Mathematics quatrain poem, published by the School Science and Mathematics journal in March 1948, symbolized Posey as a man of religious spirit and mathematical ingenuity. Posey was nearing mandatory retirement from Southern University in Baton Rouge, Louisiana. This would be his last known publication in a mathematics journal. Posey stepped away from academic life in 1950, at the roaring age of 70, but he left cultural remnants to mathematics, educational technology, and history.

Roads Traveled

Posey's journey as an educator started early. He graduated Fisk University in 1914 with an atrium baccalaureates (A.B.) degree (same as a Bachelors of Arts) in Science (Vincent 1981; Commencement Program 1914). Shortly thereafter, Posey presided as superintending principal at Attucks High School – the first full high school department of the black schools in Christian County, Hopkinsville, Kentucky (University of Kentucky n.d.). Attucks was built in 1916. In addition, it was said to offer the same

curricula of the white high schools that included a traditional academic curriculum of English, Science, Language, History, and a host of electives (Meacham 1930). The school was known for its "four week industrial institute for Negro teachers" (Petrie 1939).[1]

In 1925 and 1926, Posey matriculated as a graduate student at the University of Chicago. He attended three quarter sessions at the Graduate School of Arts, Literature and Science. His transcripts revealed a series of courses indicative of a mathematics education focus; some of those courses included Elementary Theory of Equations, Teaching of Secondary Math, Teaching of High School Math, and Use of Tests in Improving Instruction. His grades were modest which might account for why he did not complete his studies at the University of Chicago. That is, no degree or certification was conferred.

Posey did not let the bump in the road at the University of Chicago deter him. Several years later, he completed his thesis, *A Critical and Historical Study of De Moivre's Theorem with Applications*, earning the Masters of Arts degree at The Ohio State University. He was 50 years old. Posey's thesis outlined the life works of Abraham De Moivre (1667–1754), a French born mathematician, and argued for several uses of De Moivre theorem as it related to complex numbers and trigonometry (Posey 1930).

Posey spent most of his professional work years at Southern University, a state-supported southern black university that was chartered in 1880 in New Orleans, Louisiana (later relocated to Baton Rouge in 1914). In 1923 Southern University, although established as a university, operated as a high school with curriculum focused on domestic science, industrial arts, and an elementary education (Lane 1971). Instructors only needed a bachelor's degree. Southern University grew from its "advanced elementary school" status to college-level accreditation in 1937 (Lane 1971, p. 133). Accordingly, Ulysses Simpson Lane described the years from 1920 to 1940 at Southern University as "The Great Transition: From Unknown To Known" and the period from 1940 to 1950—"The Maturation of the University" (Lane 1971, p. iv).

The university ran with a commitment to service and uplift (Vincent 1981). Felton Grandison Clark resided as president of Southern University for 31 years (1938–1969); he was the son of the former president Dr. Joseph Samuel Clark whose tenure ran from 1914 to 1938 or 24 years (Vincent 1981). Posey's years at Southern University coincided with both presidents. According to Posey's December 6, 1943 employment form, he began his state service as a 'mathematics teacher' in 1923 (L.R. Posey, personal communication, December 6, 1943). The title of mathematics teacher was indicative of the time period and Southern University's institutional status.

Posey and his colleagues at Southern University maintained a custom of written formality. Personal and professional correspondence was often received on letterhead via handwritten or carbon-copied typed formats. Engaging in written correspondence was tradition, courtesy, and a way of covering oneself from scandal, ruin, or the

[1] Petrie, Charles John. "The History of Education in Christian County." University of Kentucky, 1939,183-189.Attucks high school was named after Christopher Attucks, a black solider of the American Revolution who was one of the first African Americans to be killed.

like. The university monitored faculty time through its permissions process. In 1941, protocol for faculty included written permission to leave campus, attend conferences, and teach. A fill in the blank form letter often sufficed and was delivered to President F. G. Clark himself. In the form letter dated October 8, 1941, Posey requested permission to leave campus. The letter stated: "I L. R. Posey, respectfully request permission to be absent from the campus beginning Oct. 11 and ending Oct. 11 for the purpose of delivering an address to the Washington Parish Fair. Proper arrangements as indicated below have been made to take care of my classes and other duties during my absence: Mr. Smith will take charge of classes." This form letter was signed by Posey as employee. Then, Posey signed again, because he was department head. Next, Dean John B. Cade signed the request form, and finally, the request was approved with the university president's signature—dated Oct. 10, 1941. Permissions extended to a ranking system of administrators who would say "yeah" or "nay" to faculty actions and activities. Was this a system of control or formal evaluation? Examining Posey's written correspondence reveals an employee process that calculated and monitored faculty behavior and time given the unmonitored nature of academia.

DUTY: Teaching

Duty can sum up the man behind Posey. Bound by duty, Posey taught mathematics in the fall, spring, and summer semesters throughout his tenure at Southern University even during his years as an administrator. Some of his course titles examined Algebra, Differential Calculus, and Theory of Equations. Several courses Posey created in the summer of 1943 focused on addressing the war efforts. In his handwritten notes, Posey's course descriptions stated:

> 111a. The Teaching of Public School Mathematics. This course comprises three groups of subject matter. Group I. The Teaching of Arithmetic. II. The Teaching of Algebra. III. The Teaching of Plane Geometry. Approximately four weeks will be devoted to each group. The main purpose of this course is to discover better methods of teaching these courses or to improve the ones known. Particular attention will be given to difficulties found in both student and teacher activities connected with these subjects. The teaching procedure will be a sort of combination of the lecture, project and laboratory methods. This course is introduced this summer to aid the war emergency program in the teaching of mathematics. Prerequisite one year of teaching experience or one semester of Education. This is a one semester course and does not count as a major in math. Credit 3 hrs (L. R. Posey, personal communication, handwritten notes "Activities Engaged in by L.R. Posey since September 1942 to May 31, 1943").

> 131a Aircraft Mathematics: This course may be elected instead of Algebra 131. It is introduced for speeding up necessary information on war time mathematics. Fundamental concepts and ideas of arithmetic, algebra, geometry and trigonometry, as applied to the war effort will be stressed. It is essentially a problem course and calls for initiative and sound thinking on the part of the student. Credit 3 hrs

(L. R. Posey, personal communication, handwritten notes "Activities Engaged in by L.R. Posey since September 1942 to May 31, 1943").

Posey held to his duty as an educator and designed courses to this mission. Helping others understand mathematics was more of a calling. He sought better methods of teaching mathematics and tools to enable learning.

On May 10, 1944, the friction between Posey and Dean Cade seemed more evident. Dean Cade wrote Posey that in accordance with his contract, he was expected to teach during the summer session beginning May 29 and ending August 19, 1944 (J. B. Cade, personal communication, May 10, 1944). Two days later, May 12, 1944, Posey wrote Dean Cade a short handwritten note in response: "Dean Cade: You may expect my service for the summer session. Yours truly, L. R. Posey." Posey's insolence from university protocol may have been symptomatic of his aging years or how fed up he was with the constant monitoring of his every movement. Usually without fail, Posey wrote his standard one-line letter to the Dean of his intention and availability to teach in the summer. Teaching in the summer was required. So why was written notification needed. The process and procedure of reporting ones work time had not changed in 20 years.

Posey seemed bound by his duty to educate others and his own selfless committment to the profession. Teaching, through whatever means, became his life's work.

DUTY: Research

Southern University was not a research university that required publications from their faculty. However, starting in the early 1940s, the charge to publish became more prominently required. Posey dabbled in publishing several pieces amidst his teaching loads and later administrative duties. He published several articles in the journal *School Science and Mathematics*. The articles published in this journal focused on mathematics education and making mathematics more accessible to the average student or layperson.

Unlike most other years, Posey's August 2, 1944 employment contract explicitly stated the requirement of faculty to "improve scholarship" (L. R. Posey, personal communication, September 1948 to 1949). Times were changing at Southern University. Posey had already begun publishing but maybe not to the extent desired by the university. Throughout the school year, a form letter was distributed soliciting scholarly articles for the university's in house publication *Southern University Bulletin—Creative and Research Issue*. Posey contributed his scholarly article entitled *An Easy Method of Deriving the Elementary Number*: *Facts of Arithmetic* (J. B. Cade, personal communication, March 16, 1945).

A publication was a congratulatory moment at Southern University. Consistent with the usual protocol, President Clark congratulated Posey on his publication of "Change of Base" in the December 1946 issue of *School Science and Mathematics*, and then, he asked Posey to stand for an interview in the Southern University Digest (F. G. Clark, personal communication, December 17, 1946). Dean Cade extended his support of Posey's scholarly work lauding his poem *The Psalm of Mathematics* as a "provocative piece of literature" and that he hoped Posey would submit the poem to Southern University Digest [1947] (J. B. Cade, personal communication, October 23, 1947).

DUTY: Service

Participating in Southern University's faculty meant serving one master—Southern. Good, bad, or indifferent, Posey yielded to Southern University as his life's mission ordered by God.

On August 15, 1946, Posey wrote Dean Cade a rousing note of his stay at Ohio State University's Mathematics workshop. Posey enthusiastically felt that the workshop prepared him to conduct a similar mathematics workshop or consult in this area. Posey bragged about this experience and its benefits; he wrote, "In addition to this I get 8 more quarter hours of graduate credit, which gives me about 48 quarter hours above the master's degree to say nothing about my experience and efficiency as a teacher." Posey further informed the Dean that President Clark promised to continue his "time on the payroll" if he attended the workshop. He reminded the Dean to let Mr. Little (the auditor) know and President Clark of his promise. In the letter, Posey noted that no one "colored" was there at the workshop doing graduate work in mathematics (L. R. Posey, personal communication, May 21, 1946).

Posey's duties as a faculty member involved cultivating a spiritual life. Faculty regularly conducted mid-week prayer meetings (Lane 1971). For example in a one-line letter, Dean Cade wrote Posey informing him that he had been selected to offer the Thanksgiving Prayer on November 21, 1940 at 10 a.m.

Faculty and staff served in Southern University's Sunday School; this included Dean Cade and Presidents F. G. Clark and J. S. Clark. Posey held the position of Sunday School Superintendent. Faculty and staff served as sponsors of classes aiding in the facilitation of class instruction and management. Classes were designated based on the academic rank of students (e.g., junior, senior). Posey proposed the following as Sunday School objectives adapted from the David C. Cook handbook (Sunday School Committee Outline, 1942–1943):

Blurring the lines between academic/religious duty and spiritual fulfilment:

1. To make Jesus and His teaching a reality in the life of each member.
2. To develop a working knowledge of the Bible as God's word and a guide for living.
3. To encourage the application of Christian principles to basic social problems.
4. To foster enthusiastic and intelligent participation in the total church program
5. To enrich the personal religious life of each individual.
6. To arouse the desire to attend church and Sunday school.
7. To help boys and girls build a Christian philosophy.
8. To develop the idea that God is the loving Father of all.

Posey's yearly faculty report demonstrated a man committed to his profession and service. He reportedly served the community in many capacities. Posey lectured at Mt. Pilgrim Baptist Church (April) and Southern University's Vesper Service. He gave addresses to the commencement ceremony at Vernon School (April 29) and Crowley (May 28). Posey was an active member of the Red Cross, Boy Scouts, Louisiana State Teachers Association, Teachers (American) Association, and N.A.A.C.P. (L. R. Posey, personal communication, September 1942–May 31, 1943). He spoke about the *Eight Essentials of Christianity* on February 6, 1948 at Rev. Calvin's Church in Baton Rogue.

In June 1949, Posey gave the Father's Day address at Camphor Memorial. He further served as consultant/advisor to a Scotland church, located in East Baton Rouge Parish, where he once advised on the topic of How We Grow [1948] (L. R. Posey, personal communication, September 1948–1949).

In a letter dated June 15, 1944 to Dr. F. G. Clark, Posey signed the letter as L. R. Posey, Chairman. That is, Posey was now chairman of the Department of Mathematics and Physics (L. R. Posey, personal communication, June 15, 1944). Posey was compliant to upper administration needs as he hired faculty and students, recruited students in his program, and monitored the budget per the specifications of upper administration. With the high turnover of faculty, Posey rushed to hire the best and brightest talent to his program (L. R. Posey, personal communication, August 15, 1946 and July 15, 1949). That is, Dean Cade wanted to maintain a balance between those faculty with bachelors versus masters degrees to "safeguard our standing with rating agencies," he wrote (J. B. Cade, personal communication, July 18, 1949).

By 1949, the growth of Southern University was readily apparent by the number of courses Posey proposed for Mathematics instruction; however, also apparent was the high failure to educate students in this content area. Posey scheduled 28 sections of courses such as Basic Mathematics, College Algebra, History of Mathematics, Integral Calculus, and Modern Physics for the fall semester. This was followed by his estimation that 15 sections of Basic Mathematics would be needed for pupils who failed courses in the fall. He calculated this as 15 sections of 30 pupils in each class for a total of 450 pupils. Posey wrote in his notes, "New freshmen and failures will approach this number, I believe" (L. R. Posey, personal communication, Fall semester, 1949).

Posey may have been saddened by the academic failure of so many pupils who had the potential for much more. His desire to create technologies to improve learning was out of desperation, desire, and a commitment to help his others.

Family, Feelings, and Final Days

Posey's life as a mathematics teacher and then chairman may have been viewed as a charmed life. He received a monthly salary of $200.83, worked most summers, and received a "perquisite of house" of $240 per year. It would seem that Posey and his family lived on campus in some type of university housing (J. B. Cade, personal communication, August 2, 1944)[2].

Throughout his tenure at Southern University, Posey fought for what he felt were salary disparities. In August 1943, President F. G. Clark responded to Posey concerning his salary indicating that it was "a supplementary salary of sizeable stature to administer the affairs of our extension program. This salary was exceeded by only three others in the entire university" (F. G. Clark, personal communication, August 28, 1943). In addition, the supplementary salary was continued when the work ceased. Posey blared

[2] Additional support that Posey lived in university housing was a letter he sent to Dean Cade on September 1, 1944. Posey asked Dean Cade to keep an eye on his house and garden for him. (Leroy R. Posey to John B. Cade, Handwritten letter about trip to Rockdale, TX, 1 September 1944. Volume 35, No.1, Leroy Raadel Posey Papers. Southern University Catalog Collection, John B. Cade Library). In addition, Posey's 1943 contract indicated Southern University, Scotlandsville, LA, as his home address. L.R. Posey employment form, December 6, 1943. Volume 35, No.1, Leroy Raadel Posey Papers. Southern University Catalog Collection, John B. Cade Library.

back at F. G. Clark in a handwritten letter where he calculated that the $600 yearly increase was thwarted by a 10% cut in university salaries and reductions in workload that amounted to less than 12 months. Posey stated,

> "I got 3/20th to 3/10th of the proposed increase. This was unfortunate for me because most of my fellow teachers always hinted to me that I was a favorite of your father and that he had made this great difference on that account. I have never gotten as much as most people, including you, think I have. Thanks for the consideration. Yours truly, L.R. Posey" (L. R. Posey, personal communication, September 1, 1943).

For Posey, the years of giving and what he got in return – did not add up. Having devoted a large portion of his life to a profession that barely paid his bills became a frustrating life lesson. For many academics, this rings true.

Posey wrote Dean Cade to inform him of his emergency trip to Grambling on May 25, 1947. He asked Dean Cade to attend to any affairs or issues that may arise and to also inform the President if asked. It seemed that the long history between Posey, Dean Cade, and President F. G. Clark was one of mutual respect, dedication, and commitment. Posey entrusted his work, life, and love to these men and the university despite his grumbling desire to be more, do more and earn more (L. R. Posey, personal communication, May 25, 1947).

By law, L. R. Posey, Active Register Number 11075, was not allowed to teach beyond July 1, 1950. Posey had reached the mandatory retirement age of 70 years. He gave formal notice of his retirement to take effect at the close of the 1950 summer session (F. G. Clark, personal communication, April 14, 1950; P.C. Rogers, personal communication, April 17, 1950).

Posey's colleagues organized the LR Posey Retirement Recognition Committee endorsed by Dean Cade (J. B. Cade, personal communication, June 14, 1950). The ceremony was entitled Convocation "L. R. Posey Day." Plans for the convocation included (1) devotion, (2) musical number, (3) testimonial speech—old student, (4) testimonial speech—new student, (5) musical number, (6) presentation of a gift (watch), (7) acceptance speech—Mr. Posey, and (8) The Alma Mater. Significant to the ceremony would be the establishment of the L.R. Posey Loan Fund (K. C. Miller, personal communication, June 19, 1950).

Posey's last official letter in 1950 went to Mr. B. A. Little, Auditor for Southern University in Baton Rogue (J. B. Cade, personal communication, July 6, 1950). He stated:

> Dear Mr. Little:
> Since I have received my last official check, from Southern University from the stand point of the Retirement system of Louisiana, and since Dr. L. R. Posey (his son) is to be my successor, according to President F. G. Clark, I am requesting the house rent, light and gas bill of $22.20 which was normally deducted from my monthly check be deducted from the monthly check of Dr. L. R. Posey. Jr.
> I am having Dr. Posey to sign this request jointly with me to make it official.
> Thank you.
> Very truly, L. R. Posey (signature) L. R. Posey, Jr. (signature)

Posey passed the baton to his son urging the university to extend to his son all the rights and privileges of academic life—housing, salary, and service. For Posey, the transference of academic life to an unknown future was bittersweet.

Posey–The machine
The Psalm of Mathematics (continued)
Skill is slow, and time is fleeting.
Study, practice and be brave,
Don't try stealing neither cheating
Such will make you but a slave.
In the world's broad field of math
In the youthful span of life
Be not like dry worthless chaff
Be a worker in the strife
Trust no guessing howe'er pleasant!
Let sound thinking be thy guide?
Act–act in the living present!
Heart within, have a scholar's pride (Posey 1948, p. 225)

As the poem continues here, Posey urges youth to not waste any more time; they must have the courage to learn, study, and practice. There are no shortcuts in mathematics. Cheating just makes you a "slave" to cheating again. He encourages youth to see their value and work hard. No guessing is needed when studying; rely on your own knowledge. Posey harkens youth to think of themselves as scholars.

Posey devoted his life to helping youth and young adults unlock the mysteries of mathematics. This devotion became evident in his 1940 patent that outlined an educational device, the Combination Slide Board (Posey 1940c). It was called a combination because it had components similar to a slide rule and a nomogram. A slide rule is an instrument used to solve problems involving multiplication, division, raising to a power (involution) and taking a root (evolution). The slide rule is based on the association of two or more logarithmically developed scales which, in turn, permits the use of the principle of proportion (Hills 1950, p. 11). The Combination Slide Board is similar to a nomogram in that they both are 2-dimensional calculating devices. However, a nomogram was made to evaluate the values of just one equation, where as you can perform more than one type of calculation using the Combination Slide Board.

Historically, teaching machines were characterized as "constructed educational devices for individual self-instruction" that had "important implications for

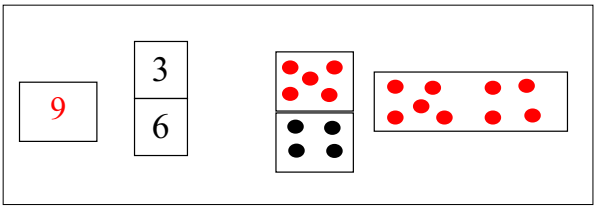

Fig. 1 Combination Slide Board: Representations of Multiple Sight Openings

educational practice" (Lumsdaine 1960, p. 5). One of the earliest examples of educational aids was developed in 1866 by Halcyon Skinner who patented a spelling machine to aid teachers (Benjamin 1988; Stolurow and Davis 1965). Teaching machines became popularized in the early 1960s. Psychologists conducted experimental studies using these machines to determine "effective learning" (Lumsdaine 1960, p. 5); some theorized that the "close control" of the machine might enable the learning process (Pressey, 1932, p. 672).

Posey believed his "Combination Slide Board" invention served two purposes (Eidson 1956, p. 270). First, it could teach, and second, it served as a calculating instrument. Posey stated, "My invention relates to improvements in educational devices for teaching arithmetic principally to children" (Posey 1940a, p. 1). This is the first line of the US Patent #2,188,723 filed by Leroy R. Posey in Scotlandville, LA, on July 26, 1938 and fully patented on January 30, 1940 (Posey 1940b, p. 1).

Posey (1940a) described his invention as a lightweight…

> device of the slide rule type for the purpose of teaching objectively addition, subtraction, multiplication, and division facts, the meaning of 'square' and 'square roots', number sense or meaning, the meaning of remainder, the meaning of percent and fractions, and for impressing the facts of different problems upon the juvenile mind. Another object is to provide a device adapted for the purposes set forth and also for use as a calculating instrument within the limits of primary number facts and combinations, as taught to children (p. 1).

The most common use of a slide rule was its purpose to obtain quotients or products of numbers (Hills 1950). At a time pre-dating the proliferation of scientific calculators, these devices were essential tools for trignometric, exponential, and logarithmic computations, and those involving complex numbers: a focus of Posey's research. However, the Combination Slide Board served multiple purposes.

Posey's Combination Slide Board adopted some of John Napier's ideas of logarithms and performing operations of division and multiplication (Lucas 1885; Memphis World 1954). Besides the sliding function, Posey's Combination Slide Board did not resemble traditional slide rules of the 1940s and 1950s that displayed logarithmic meanings of C and D scales. Posey (1940b) called his invention of the "slide rule type" and classified the patent as an "educational device" (p. 1). As an educational device, the Combination Slide Board was meant to teach. This was made explicit in the patent when Posey stated that his invention was a "device of the slide rule type for the purpose of teaching" (p. 1). If the purpose of the device was for the teaching of mathematics, then it could be classified as a teaching machine. The following section defines the criteria of teaching machines and aligns the criteria with Posey's interpretation of the Combination Slide Board:

> A teaching machine is an automatic or self-controlling device that (a) presents a unit of information (B. F. Skinner would say that the information must be new), (b) provides some means for the learner to respond to the information, and (c) provides feedback about the correctness of the learner's responses (Benjamin 1988, p. 704).

Self-Controlling

Posey's (1940a) Combination Slide Board can be classified as a self-controlling device based on the patent's description of use that stated it required "moving the number-combining slide" (p. 2). Further, the patent describes other functionalities as a "sliding movement," "movement," or "moving." Thereby, this implys that the Combination Slide Board was a self-controlling device.

Unit of Information

Next, the Combination Slide Board has to present a unit of information preferably new information to the learner. The patent makes multiple references to the device having a "base number of display panel" and a "rectangular panel." These panels were meant to display number symbols or a unit of information. Posey writes in the patent that the Combination Slide Board could "display different number facts of problems objectively," "display through the openings thereof the problems and the dot-combinations corresponding in total values thereto," "display combinations of symbols in lines," and "display therethrough the multiple number symbols." This information implies that the device provides a unit of information that presents new information. Specifically each time the Combination Slide board is moved by the learner, it displayed new information as number facts and dot combinations.

Respond to Information

The next criteria to classify Posey's Combination Slide Board as a teaching machine is to provide some means for the learner to "respond to the information." In the description of the use of the device, Posey (1940b) provides the following example: By moving the "number-combining slide" to display the equation 3 plus 6, the answer is displayed numerically in red as seen in Fig. 1. Given the position of the slide, the dot symbols display an equivalent equation but different number facts that equal the same answer (i.e., 5 plus 4 equals 9). The answer is displayed in red providing a concrete representation of this abstract problem. Following the behavioral model, a stimulus and response scenario is created. The stimulus is the correct answer or 9. The response to the correct answer is that the device displays "another problem with the same answer to impress upon the mind of the child different number facts objectively" (p. 2). Thereby, the learner solves for the equation 3 plus 6, learns that the answer is 9, and also learns that 5 plus 4 equals 9. The response to the information is not a physical movement by the learner, but the response to information is cognitive in that the learner acquires new knowledge. That is, there are multiple combinations of number facts that equal 9.

Color also played a significant role in how learners acquired knowledge. Posey adds that "In each case the number to be added is red and the answer red thus further impressing the problem on the mind of the student." Again, the response to the information is cognitively acquired by the learner—the learner does not have to manipulate the slide board.

Feedback on Correctness

Feedback about the correctness of the response is displayed through designated sight openings in the Combination Slide Board. Number facts are colored black and red. Answers are visually demonstrated as red numbers or red dot combinations; however, red dot combinations also meant add this value. The patent states that the device will "indicate the answer to any selected problem" (p. 3). Therefore, feedback on the correctness of a response is demonstrated through a visual display of an answer to a selected math problem.

Posey's Combination Slide Board satisfies all the criteria for a teaching machine. Therefore, it merits classification as a teaching machine.

Between the period of 1925 to 1950, the history of teaching machines went dead. It is hypothesized that these devices did not catch on because they were seen as testing devices first and teaching machines second (Lumsdaine 1960). Given this, Posey's teaching machine serves a significant place and space in history.

Posey–The Mathematics
The Psalm of Mathematics (continued)
Great mathematicians all remind us
We can make some mark of kind
And, departing leave behind us
Blueprints of creative mind
Blueprints, that perhaps another
Failing math's primary aim.
A forlorn and doubtful brother
Seeing, shall take heart again.
Let us then be up and going
Keeping heart both soon and late
Still achieving still pursuing
Learning math at a normal rate (Posey 1948, p. 225).

Posey sought to make a mark on society, the profession of mathematics, and students. The "blueprints" Posey left are in the form of his patents and scholarly work; he hoped someone would continue his legacy. He urged all who read this poem to continue to achieve, pursue, and enjoy mathematics.

The publications and works of Posey present the story of an instructor—a professor who sought to make mathematics more accessible to the average student or layperson. Although he worked mostly in teaching colleges, Posey was able to publish selected works about mathematics. As stated, he published several articles in the *School Science and Mathematics* journal (Posey 1934, 1935, April 1940, 1946, and 1948).

In examining Posey's published works, his mathematical ideas seem elementary in the sense that they are commonplace tools readily used in College Algebra, Trigonometry, and Complex Variables (Analysis) courses; however, this information was not as commonplace in 1940–1950. Specifically, the distinctions between what we now view as the three primary branches of mathematical research: Pure Mathematics, Applied Mathematics, and Mathematics Education, were not evident.

Pure Mathematics focuses on the Abstract, and it is very theoretical. Applied Mathematics means the application of "pure" mathematics to other disciplines (predominantely in, but not limited to, STEM fields such as Physics, Engineering, Biology, Physiology, etc.). Mathematics Education is the study of teaching mathematics and pedagogy. The culmination of Posey's publications indicates a focus on Mathematics Education given that most of his works were produced with the purpose of explaining mathematics to students. He had the intent of explaining concepts related to complex analysis and number theory so that the information was accessible to students. For example, Posey provided a brief history of the number system that stated:

> Having a unit of measure on base 10 and a number system on base 10 make it easy to change units to lower or higher denominations. The English system which is a mixture of many ancient number systems is difficult because each column which is to be added, subtracted, multiplied or divided, is on no definite base (Posey 1946, p. 872).

In several of his published papers, Posey clearly argues for easier ways to understand number systems and mathematics. In his article "A Correction Concerning i^n", Posey asserts that his methodology is actually easier than the one offered in the Wells' College Algebra text in that it does not require the memorization of a table. In complex analysis, i refers to the square root of -1, $\sqrt{-1}$. All real and complex numbers can be written in the form $a + bi$, where a and b are real numbers. Understanding the results of raising i to various powers of n, i^n, is essential to computations and applications of formulas in complex number theory. He wrote: "All you need to remember is that odd powers of i give imaginary results when the power is decreased by one and divided by two and that even powers of i give real results when the power is divided by two" (p. 198). In another article, Posey (1935) proposed an easier way to compute for the nth power of i than the traditional manner which was offered.

In the article "Change of Base," Posey (1946) describes a method of rewriting a number based on its "base." The premise behind this method is that every real number can be written as some other number (i.e., a "base") raised to the power of some other number (i.e., an exponent). In order to evaluate $\log_a N$, students are asked to determine "to what power can we raise a to get N."

Posey also checks his methodology with the standard change of base formula $\log_a N = \frac{\log_b N}{\log_b a}$, a formula that rewrites a logarithm of a number that is originally expressed in base a with that of the quotient of logarithms with base b. Posey asserted "Rather it throws light on how to think and work with the common system more effectively. If this article makes the reader reflect on and think more critically about the way in which our number systems, and mathematics in general, grew and developed, the writer will feel that the effort was worthwhile" (Posey 1946, p. 878). From this statement, the idea of supplemental instruction is reinforced. Posey again focuses on rewriting traditional mathematics in a different light to aid the reader's understanding. Given the method he describes in the paper, it is unclear whether or not this method is sound for all values of a, b, and N. A traditional proof of this methodology is not present; further, a proof would have been beneficial to ensure that the methodology worked for all cases.

Conclusion

The Combination Slide Board made an impact in various communities. In 1954 Memphis World, an independent newspaper, touted the headline *Instructor Receiving Acclaim for Invention Used In Math*. This was 14 years after Posey's patent approval. The article reported that the Combination Slide Board was used by teachers throughout Louisiana and Mississippi. Eidson's 1956 dissertation research on *The role of instructional aids in arithmetic education* documents the Combination Slide Board as one of the instructional aids "which tends to promote understanding of the twenty-three basic concepts of arithmetic" (p. 52). In a list of manufacturers and distributors of certain arithmetic instructional aids, L. R. Posey, Southern University, Baton Rouge, LA, is listed with other notable companies such as Parker Brothers, Houghton Mifflin Company, Simon and Schuster, Playskool Manufacturing Company, and Milton Bradley Company (Eidson 1956). Given this history, it would seem that Posey had a valuable instructional technology that impacted its era and faded into history with the growth of calculators and computer technologies.

This article sought to answer the following questions: The Man: Who was the man behind the machine? Posey was a man of substance who fought to improve student's knowledge and perceptions of mathematics. The Machine: What drove Posey to patent and build a teaching machine in 1940? Could the Combination Slide Board invention teach mathematics and thereby be classified as a teaching machine? Posey's passion for simplifying mathematical concepts and making them accessible to all drove him to building the Combination Slide Board. Based on the patent, Memphis World article, and Eidson's dissertation, it would seem that the Combination Slide Board provided the components to teach mathematics. This article further analyzed the patent for criteria specific to teaching machines. The Combination Slide Board met those criteria, and thereby should be classified as a teaching machine. The Mathematics: What knowledge about mathematics instruction did Leroy Posey feel he could contribute to the education of black youth in general and the world more broadly? As an instructor, Posey sought to demystify mathematics, and unbeknownst to him, Posey contributed to the emerging field of mathematics education. Posey worked at predominately black institutions most of his career; therefore his devotion to helping black people seems most evident.

Posey succeeded in leaving several cultural remnants like his patent and other documents at Southern University so that we could begin to trace the path that led to the Combination Slide Board. Although this analysis of the Combination Slide Board did not provide an explicit cultural context to how African Americans learn, it speaks to the ingenuity of a black man (inventor) with a vision.

Further, research might explore the feasibility of the Combination Slide Board to improve learning in present day mathematics classrooms. Build the slide board and test out its merit. Posey's work leaves an indelible mark on the history of Educational Technology and (African) American history.

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References

Benjamin, L. T. (1988). A history of teaching machines. *American Psychologist, 43*, 703–712.

Commencement Program (1914). Fiskana collection-commencement programs, Fisk University, Franklin library special collections.

Eidson, W. P. (1956). The role of instructional aids in arithmetic education. In *The Ohio State University*. Columbus: Ohio.

Fry, E. B. (1963). *Teaching machines and programmed instruction: an introduction*. New York: McGraw-Hill Book Company, Inc..

Hills, E. J. (1950). *A course in the slide rule and logrithms*. Boston: Ginn and Company.

Instructor receiving acclaim for invention used in math. (1954). Memphis world publishing co.

Kay, H., Dodd, B., & Sime, M. (1968). *Teaching machines and programmed instruction*. Harmondsworth: Penguin Books, Ltd..

Lane, U. S. (1971). The history of Southern University: 1879–1960. Unpublished dissertation, Utah State University, Logon, Utah.

Lucas, M. E. (1885). Calculating-machines. Popular Science Monthly, 441–452.

Lumsdaine, A. A. (1960). Teaching machines: an introductory overview. In A. A. Lumsdaine & R. Glaser (Eds.), *Teaching machines and programmed learning* (Vol. 1, pp. 5–22). Washington DC: National Education Association.

Meacham, C. M. (1930). Meacham's history of christian county Kentucky. Retrieved February 24, 2018, from http://www.westernkyhistory.org/christian/. Accessdate 11 Feb 2019

Petrie, C. J. (1939). *The history of education in Christian county*. Hopkinsville, Kentucky: University of Kentucky.

Posey, L. R. (1930). A critical and historical study of "De Moivre"s theorem with applications. In *Ohio State University*. Columbus: Ohio.

Posey, L. R. (1934). A method of determining the sign and value of i, where i equals v-1 and n is any rational positive integer equal to, or greater than two. *School Science and Mathematics, 34*(8), 812–815.

Posey, L. R. (1935). A correction concerning i^n. *School Science and Mathematics, 35*(5), 512.

Posey, L. R. (1940a). A general formula for magic squares of various orders beginning with numbers different from unity. *School Science and Mathematics, 40*(4), 315–319.

Posey, L. R. (1940b). USA patent no. 2188723. U. S. P. Office.

Posey, L. R. (1940c). United States Patent and Trademark Office No. US00218872. Retrieved from http://pdfpiw.uspto.gov/.piw?PageNum=0&docid=02188723&IDKey=ECDA5998C63F%0D%0A&HomeUrl=http%3A%2F%2Fpatft.uspto.gov%2Fnetahtml%2FPTO%2Fpatimg.htm

Posey, L. R. (1946). Change of base. *School Science and Mathematics, 46*(9), 871–878.

Posey, L. R. (1948). The psalm of mathematics. *School Science and Mathematics, 48*(3), 225.

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Pressey, S. L. (1932). A third and fourth contribution toward the coming 'industrial revolution'; in education. *School & Society, 36*, 668–672.

Stolurow, L. M., & Davis, D. (1965). Teaching machines and computer-based systems. In R. Glaser (Ed.), *Teaching machines and programed learning: Data and directions* (pp. 162–212). Washington DC: National Education Association of the United States.

University of Kentucky. (n.d.). Notable Kentucky African Americans Database Retrieved February 24, 2018, from http://www.uky.edu/Libraries/NKAA/record.php?note_id=2649. Accessdate 11 Feb 2019

Vincent, C. (1981). *A centennial history of Southern University and A & M College: 1880–1980*. Baton Rouge, LA: The University.