

## Original Paper

# The Politics of Mathematics: Just and Knowing Societies

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### Abstract

*Educational leaders and researchers recognize that mathematics can be an effective tool in enabling substantial advances in many fields of science and technology. However, the role that mathematics can play in shaping and creating socio-political views of societies is not as well understood. Within the mathematics' learning community there is little discussion connecting the unique role that mathematics can play in conceptualizing a democratic society even within the democratic societies where that learning happens. Building capacity for learning in context is a critical piece of any comprehensive program but it is sometimes difficult for leaders to agree on what that context should and does look like. There are multitudes of influences at play when educational systems create and enact curricula but in order to push through the stalemate that can exist with different ideologies, it is essential to understand that mathematics can be a conduit to improvements in political social justice as well as a gateway to developments in science and technology. Mathematics has the potential to be a tool to create, as well as an instrument of influence; the key is for leaders to understand how to do both.*

### Keywords

*democratic, mathematics, social justice, popular education, educational decision-making, social construct*

## 1 Introduction

“utopian society of equals” (Gadotti, 2017, p. 18) where social justice would be a function of humanism and where all cultures would inevitably desire a universal human ethic. Convinced that epistemological change meant a complete overhaul of the education system Freire wanted a way to ensure that the interests of the people who were systematically disadvantaged would have a voice. The work of Freire and other social reformists unleashed a philosophical discourse that began within the

confines of the educational environment but expanded well beyond the walls of the institutions that housed the debates (Gadotti, 2017). Using education as a medium to create a new social order challenged the notion of school being solely a depository of facts and a place where learning was a generalization of information. Freire's concept of "popular education" became an impetus for change, a way for social justice to become an active and influential part of the educational system and beyond. A dream of a fair and democratic global society, by overcoming ingenuous attitudes towards knowledge and acknowledging the power potential of that knowledge, would challenge practitioners and theorists alike (Eagan, 2010).

As with most revolutionary enterprises, the work surrounding Freire's ideas would go on to be examined through a multitude of lenses. Eagan (2010) proposed that political interventionists, historical legacies and personal ideologies would all play a role in the acceptance of or the resistance to the theoretical discourse that would accompany critical reflection of the popular education practices. Researchers in education and politics knew that external influences, such as the state, could exercise and even impose power on decision making but it was sometimes more difficult to understand the historical and ideological influences connected to those same emerging theories (Broadhead, 2002). "Education is not a neutral process" (Gadotti, 2012, p. 19) and there was, and still is, a need to identify and explore the tensions as well as the achievements that exist when seeking to turn any reform policy into practice. While some of Freire's principles may have slipped into the pages of history, others have passed the test of time; the belief that "good practice does not merely replicate itself unreflectively" (Eagan, 2010, p. 429) and that educational decision making is inherently political still ring as true today as they did then.

## **2. The Politics of Education: Context Matters**

Educational researcher Michael Young weighed into the curriculum debates in the 1970s with his edited collection of writings *Knowledge and Control: New Directions in the Sociology of Education, Knowledge and Control* (Morgan, 2015). Young insinuated that every decision made in education had a foundation in a philosophical belief, even decisions that appeared to be innocuous. The *Knowledge and Control* papers went on to describe that once an educational philosophical conviction was developed then the belief would be translated into a political ideology, which in turn, created a way of thinking connected to how learners should be learning (Morgan, 2015). "Reading wars", "math wars", "curriculum wars" were all examples of battles being fought over philosophical underpinnings of what school-induced learning should be about. Political efforts throughout history had tried to resolve disputes between different ideological camps, sometimes through legislation and sometimes through advocacy. One side or the other may have won individual battles but the wars continued to play on (Boyd & Mitchell, 2001). Modern times tell a similar tale of educational governance and policy co-evolving with political transformations, as states attempt to maintain varying levels of control over schools and in turn knowledge.

Dobbins and Khachatryan (2014) examined how education systems experience turbulent change when conflicting factors such as economic fragility threatened to upset established political systems. Governing bodies had grown to appreciate that educational systems could play important roles in maintaining or regaining positions of national interest such as sovereignty or ideological orientations (Dobbins & Khachatryan, 2014). Strategists had often recognized how difficult it could be to separate the state and education, especially in systems where political influence and government interventions were connected to financial reliance. Dobbins and Khachatryan (2014) cautioned however, that even balanced state-market arrangements should not be considered simple benign responses to policy management as these systems were often calculated choices based on influences beyond the institutions themselves. While political and leadership transformation and tensions often resulted in shifted models in educational environments, Gadotti (2012) identified that leaders at all levels needed to remember that “education presupposes a societal project” (p. 19) surmising that education, politics and social issues were symbiotically entwined.

While education, and specifically curriculum, were often implicated in dominance and ideological struggles when cultural groups and systems were trying to find voice and agency, it was important to recognize that the roots of political decision making could be as varied as the reasons for those political decisions. Whether the origins of change were based within “the anarchism of industrial proletariat...; self-managed socialism; European radical liberalism; popular movements; utopias of independence; theories of liberation; and dialectical pedagogy” (Gadotti, 2012, p. 19) change in educational focus was going to happen, so reflection was an imperative. Eagan (2010) emphasized that those reflections would require a critical examination of theory and practice, grounded in the interests of systematic advantages as well as systematic disadvantages. “Policy making can be unscientific and irrational” (Broadhead, 2002, p. 60) therefore disentangling professional understanding from personal value could be difficult for decision makers especially when the policy making process was a complex array of power, influence and action. In order to create change that would withstand both intellectual debate and political scrutiny, it was necessary for leaders to be discerning in the roles they played as agents of change and how they analyzed those roles. The potential clashes between these value systems were sometimes embedded into educational policy by the agents themselves; therefore judicious attention was necessary when developing policy connected to putting theory into practice, as the processes used to promote change had the potential to influence the ideology itself (Greer & Mukhopadhyay, 2012).

Politicians and educational professionals, each with the power to shape the future both through action and through decisions, had strived to enact historical, social, and institutional constructs to “organize ways of knowing into ways of acting in the world” (Klein, 2002, p. 77). Discourse and practice contributed to how educational patterns were formulated, so while educational policies needed to be sensitive to the requirements of changing learning environments, people were still needed to provide rational objectives and direction with purpose (Broadhead, 2002). Contention over the differences between centralized versus decentralized management, linking subjects to integrated delivery, or even

raising the profile of particular areas of study could all be seen as ways to both disseminate power as well as determine effective pedagogy in politically motivated learning environments. Sanchez and Blomhoj (2010) acknowledged that educational decision-making would always be dependent on the legislative and policy frameworks that were influenced by political contexts but access to the decision making powers could be transformative.

### 3. The Power of Persuasion-Voices that Count

“The NCTM standards are ground zero in the math wars” (Loveless, 2002, p. 185).

In 1998, the Secretary of Education of the United States delivered an address at the joint meeting of the American Mathematical Society (AMS) and the Mathematical Association of America (MAA) calling for an end to what had been called the “math wars” (Loveless, 2002). According to Loveless’ interpretation, the meeting was holding the National Council of Teachers of Mathematics (NCTM) accountable for the embroiled controversy hanging over the heads of mathematical practitioners everywhere. Interestingly the joint meeting of the AMS and the MAA consisted primarily of research mathematicians and college math instructors as opposed to the NCTM group, which consisted of mainly high school math teachers and math educators from schools of education. The guiding document in question, which was created by the NCTM group, was the groundwork for the politicized change movement and would become the blueprint for how mathematics would be taught in elementary and secondary schools. While the NCTM was initially praised across both philosophical and political spectrums, the early shine soon began to wear thin. Early adopters of the “new” methods were seeing test scores on national and international assessments beginning to slide (Loveless, 2002). Advocates of the NCTM ideology were under attack and while politicians generally had stayed out of academic disputes of this kind the Secretary of Education’s foray into the arena marked a turn in government involvement (Boyd & Mitchell, 2001). The NCTM thinking had become politicized but the important question was why?

#### 3.1 Competitive Value

Researchers suggested that the last political involvement in the mathematics war was connected to the Russians launching Sputnik in 1957. The Government of the United States, with shocked resignation, had to admit that it was no longer a foregone conclusion that the Americas would lead the world science race (Loveless, 2002). While the 1960s political involvement in mathematics was a response to questions of technology leadership, the 1980 political engagement was attached to a rising tide of concern about an eroding system of education (Fullan, 2014). The United States had once again found itself in a precarious position of questioned strength on the global stage and the urgency was exacerbated when the National Commission on Excellence in Education published *A Nation at Risk* in 1983. Reports began to warn of impending doom for American children in a rapidly changing global economy if math scores continued to slip (Fullan, 2014; Klein, 2002). The underachieving curriculum became a focus of interest at the government policy table and what the public began to talk about was a

need to return to the basics. The public was responding and policy makers were listening but the conversation was heading in a direction that was the anathema to the reformist movement in mathematics.

“Solutions frequently precede problems” (Loveless, 2002, p. 191) and with minimal analytical data the NCTM released a bold report in the late 1980s to resurrect the dream of a progressive education, but this time they set out to engage the public audience rather than the academic world. Calling the proposed reforms “standards”, when no other standards existed, the NCTM began down a road to offer the public something that the political makers did not have—an actual policy for mathematical learning that included benchmarks of practice. The NCTM standards were hailed as the model for others to aspire to, regardless of the fact that there were no performance levels for previous benchmarks or field test results to support that these standards would improve student outcomes. “They were the only game in town. By default, they became what standards should be” (Loveless, 2002, p. 193). The NCTM had played their cards well and used the power of persuasion to convince a thirsty public that there was a solution to a problem that had yet to be fully defined.

### *3.2 Capitalism and Influence*

Whether the NCTM agenda was right or wrong was perhaps inconsequential in the big scheme of things. What was of consequence would be where the politics would take its next turn, in what direction, and whom would direct it? Not to be overlooked in the domain of persuasion, manufacturers and publishers of mathematic resources began to step forward as players in the mathematics’ games (Willis, 2003). When ministries or departments of education gave a seal of approval to particular resources or programs it provided a level of assurance to the public that the materials must be good. The key question that often went unasked however was connected to who supplied the evidence of the effectiveness for particular products? Publishers themselves were quick to provide data of market research testimonials demonstrating evidence of effective practice, capitalizing on educational systems that were stretched thin in terms of time, resources and patience (Loveless, 2002). Having homogeneity in marketing within the educational industry proved potentially troublesome, however, as it reinforced some of the divides between academics and practitioners as well as blurred some of the lines between good practice and marketable practice (Willis, 2003). The decision about programming had the danger of inadvertently being based on what would sell as opposed to what was actually effective.

It was understandable that commercially published materials would have an end game connected to political and economic feasibility, but it made it more difficult for systems to measure effectiveness of programs when results could be compromised by marketing for profit or for politics (Willis, 2003). As an example, in 2009 there was a federally commissioned study that examined four different programs for teaching mathematics in public schools (Viadero, 2009). Two of the programs were declared winners based on improved standardized test scores. The impact for publishers was immediate as government departments pushed to implement the proven programs despite the publishers noting that the study was not nationally represented and in spite of questions raised about whether norm-referenced

exams were the best way to determine what students actually learn. The study results did appear to suggest however that “it’s no longer at all sensible to talk about teacher-directed versus student-directed approaches” (Leinwand, as cited in Viadero, 2009, p. 1) as the two programs chosen each took a different approach to learning. While the experts connected to the study cautioned not to draw sweeping conclusions, suggestions were made that the results validated a government sponsored National Mathematics Advisory Panel’s finding that integrating both approaches of conceptual understanding and mastery of simple procedures may be the answer to at least one part of the seemingly never-ending philosophical debate in mathematics (Viadero, 2009). Perhaps the results of a study could placate two sides of an ongoing debate by declaring both approaches equally effective.

The question bears asking then: “If a nationally sponsored government study determined that resources for either side of the mathematics wars could work, would there be a political benefit for governmental leaders and others?”. It warranted mention by Viadero (2009) that the results were similar for both of the winning programs even though the study did not adjust for differences in how the programs were implemented. The study also did not account for other differences such as how much daily instructional time was used, how much teacher preparation and support was allocated or even how long student improvement results were followed. It was noted that the hardest program to be implemented (which was not one of the winners) was the one with the least amount of support and whose results were monitored for the shortest period. A number of potential questions were raised about the long-term reliability of the results based on some of the methods used in the study. It appeared ironic that what may seem to be an inadequate mathematical process was used to study programs in mathematics. Noting that lack of curiosity could lead to corollaries that may be controlled by marketing strategies rather than fact based decision making, some researchers called for further exploration of the programs chosen. If no one asked the right questions then could educational systems run the risk of demand becoming a product of advertisers and public relations departments?

### *3.3 The Making of Results*

Marketing and politics in education were big business and the role of marketing was beginning to change. Achrol and Kotler (1999) identified that the impact of promotion, driven by dynamic and knowledge-rich environments, was changing in profound ways in the newly evolving knowledge-driven society. Experts were purporting that marketing was no longer just about selling a firm’s output, marketing strategies were poised to have much greater influence on what content was emphasized. Strategies that were better adapted to knowledge-rich environments were changing the boundaries of traditional marketing impact (Achrol & Kotler, 1999). Specifically in education, analysts had identified that the role of marketing was not only to investigate the market, promotion could also be used to influence consumers’ needs and aspirations. Marketers were realizing that opportunity networks could be organized around customers, with a core strategy to collect and disseminate information not only to customers but also about customers (Achrol & Kotler, 1999). Philip Kotler, who was regarded as a marketing expert, mirrored Achrol and Kotler’s (1999) assertion that marketing

should be viewed as a “human activity orientated in the direction to satisfy...needs and wishes” (Platis & Baban, 2010, p. 1128).

The product effectiveness and placement factors of marketing strategies had the potential to affect what users in the classroom should or could be interested in but the ministries and departments were the intended targets of price and promotion pressure. While marketing strategies needed to include an ideal marketing mix it was not lost on publishers that governments, the politicians, were often holding the purse strings so directed marketing was aimed squarely into the educational-political fold (Platis & Baban, 2010). Promotion in mathematics had proven to lead to considerable pay offs as well as payments, so decision makers had a responsibility to ensure that the results warranted the investments. Fiscal responsibility was a consistent mandate for government systems, systems which were run by politicians but influenced by the public, so strategists knew where to turn next in order to target “consumers” of education—directly into the fray of the court of public opinion. Educational leaders, politicians, as well as publishers of educational materials, were all looking for the requisite exchange on their investments (Achrol & Kotler, 1999; Platis & Baban, 2010).

Whether public opinion would have a positive impact or a negative impact on a particular agenda was often inconclusive but what policy analysts seemed to be able to agree upon was that opinion would have a strong influence on what public policy would look like. While “no one believes that public opinion always determines public policy; few believe it never does” (Burnstein, 2003, p. 29). In the world of the mathematics wars, everyone seemed to have an opinion and often the most effective way to have a point of view heard was through mass media. In 2012, educators Taylor and Collins wrote an article shedding light on the potential power of popular media on the development of national curriculum. The article identified that providing a media platform, readily accessible to the public, could have significant impact on policy formulation. “Recurrent, scathing and agenda-setting campaigns resonate in ministerial offices and the corridors of bureaucracy” (Taylor & Collins, 2012, p. 532). The authors noted that a particular newspaper in Australia for example was able to invoke enough pressure through public media to effectively influence a significant change towards a neo-conservatism view of historical national curricula. The powerful effect of a handful of editors and journalists, with a particular political disposition, drew attention to the vulnerability of education as a potential forum for political thrill-seekers. Taylor and Collins (2012) explained that even though citizens were warned that the facts provided were selected historical realities chosen based on their usefulness as political influences rather than balanced reportages, the public still bought into the rhetoric. History sometimes has a way of reminding us that truth and propaganda do not always synchronize perfectly.

Educational leaders were constantly in a state of flux, often trying to run on the parallel tracks of public and political agendas. When an average citizen wanted to know more about an issue, such as details about school or curricula, they would most often would get that information from mass media sources, even though those sources were often well outside the influential scope of scholarly academia: “*The Formula for Fixing Canada’s Math Curriculum*” (Huffington Post, 2017), “*Just Fix the Bloody Math*

*Curriculum*” (CBC News, 2017), “*Ontario’s Math Scores Started Declining as Kids Took the New Curriculum*” (National Post, 2016), “*Saskatchewan Looking at Math Curriculum Overhaul*” (Global News, 2017). Headlines are good at stirring up interest but unfortunately, headlines do not tell the full story, and as Taylor and Collins (2012) pointed out—often not even the full story was what reasonable people would agree upon anyways. Boyd and Mitchell (2001) acknowledged that the more salient an issue was, the more demanding the public would be of their politicians and their educational leaders and as “power was being wrestled from educational professionals, teachers unions, and ministry officials” (Boyd & Mitchell, 2001, p. 72) the intensity of those pressures appeared to be growing. When mass media claimed that the solution to the mathematics problem was easy, educational leaders understood that there was still more work to be done. Educating the public was not going to be an easy task but leaders understood that there was no simple fix to very a complex problem.

#### **4. Resuming Old Themes: Still Leading**

While Freire would have been diametrically opposed to the neoliberal notion of education where standards of performance are coveted and education was seen as private capitalist enterprise, philosophical clarity for contemporary school systems was more complicated (Gadotti, 2017). Educational leaders needed to contend with disputes about content and pedagogy while remaining keenly aware that the conflicts were about much more than curricula. Adjusting to important social changes in education, reflecting fundamental moral and political ideologies, and dealing with economic realities were all part of the equation for decision-makers (Gutstein, 2012). Decisions about which path would lead to the best student outcomes put educational leaders at ground-zero in an explosive world where points of conflict between progressive and conservative educational philosophies were designed to collide (Mitchell & Boyd, 2001). Political will, driven by public opinion, could sometimes displace innovative scientific analysis despite the best efforts of well-intended academic and political leaders. High-stake performance assessments could be strong drivers in the pursuit for academic excellence and economic competitiveness could easily obscure educational reformists who were trying to function on the foundations of social equity and political liberation.

Morgan (2015) used the example of societies that were dominated politically and economically by blue-collar working class people who often leaned towards neoliberal forms of schooling as opposed to a more socially democratic foundation. If school knowledge is a social construction that tends to represent the interests and beliefs of the most powerful group in society then the current suggestion of a “back to the basics” mode of delivery in mathematical education may follow the same line of thinking that Morgan had proposed. With a conservative leaning political party at the helm, it was feasible that there could be a stronger will for a spirit of capitalism associated with decision making. Combining a more-to-the-right platform of political view with a sharp downward turn in economic stability lends itself to a government re-concerning itself with how to allocate resources according to publically perceived needs (Morgan, 2015). Taking for granted the assumption that all forms of social evolution



will lead to gradual improvement, the idea that political arithmetic, or the redistribution of resources based on public interest, seemed like it would be a reasonable solution to any government's economic problem (Sanchez & Blomhoj, 2010). The concern for educational leaders, however, went beyond pure economics and politics. Leaders in education needed to understand how school curricula and programs enacted, both through content and form, would distribute different types of knowledge to different types of students—building on the argument set forth by Morgan (2015) that “curriculum is more than just a means of seeking and transmitting knowledge” (p. 8).

The impact of standardized test scores, combined with mainstream media analysis, can play a significant role in political sways connected to curricula and practice as well. As an example, a conservative leaning government within Canada responded to reports connected to low PISA (Organization for Economic Co-operation and Development, OECD, Programme for International Student Assessment) scores in mathematics:

“We are also monitoring the math scores of ... students in international tests, and they are disappointingly low. To improve math scores and ensure all ... students are well-schooled in the basics of math, my government will expand math reinforcement and supports, broadening access to common-sense methods that have been proven successful in the past and in other jurisdictions. New international models will also be explored” (Schofield, 2017, p. 4).

What the official government statement did not connect to however was the coinciding trend in reduction of funding that had accompanied the downward trend in scores. In 2009, researchers Aydin, Uysaland Sarier reviewed and correlated data connected to OECD countries and PISA scores to determine what impact the mobilization of resources towards policies that enhance individuals' social and economic prospects might have on international standardized test scores. One of the findings of the study was that socio-economic equity was still one of the most powerful factors that influence student performances. Contending with reduced economic inputs and growing demands on those funds could lead the public to understand that if funding changed in education, there may be a correlated change in results. It may be easier for governments to direct blame towards inadequate curricula or practice to explain disappointing test scores but further analysis by international researchers sometimes tell a different story (Aydin et al., 2009).

The Aydin et al. (2009) study drew attention to the importance of public accountability and raised awareness as to what effects centralized versus decentralized levels of governmental decision making could have on student achievement. It was noted in countries where school autonomy was more common, students tended to score better in math and the other assessments. The study presented the argument that in order for schools to function better, a professional climate that holds choice, authority and responsibility in high regard tend to see better results. While the PISA study suggested that decision making powers should lean towards being decentralized, the increased drive and demand for effectiveness and efficiency could sometimes make decentralized decisions feel counterintuitive for governing bodies. Having control, or at least having the ability to guide educational culture, had the

potential to provide governmental bodies with better understanding of curriculum and pedagogy need but it also created opportunity to have influence on what would become social knowledge (Morgan, 2015).

Particularly in times of uncertainty, political leaders recognized that the powerful interests that shape school knowledge would have an impact on what shaped societal thinking. The implications of educational leaders becoming too dominant however could be somewhat threatening for governmental agencies especially in turbulent times when philosophies begin to clash and political will begins to shift (Morgan, 2015). Recognizing that being able to gain control over the learning environments was a way to maintain the balance of power between politics and academia was critical especially if the ability to hold onto power was beginning to feel more and more difficult (Apple, 2010). Governments wanted, and needed, to be able to control the direction and will of the people and education was a resource that would enable politicians to do just that. Politics controlled finance, finance controlled content, and content controlled thinking; the wheels were turning but it was often hard to discern a direction.

### **5. Mathematics as Democracy**

Author Eric Gustein (2012) called mathematics a “weapon in the struggle” for social justice, laying out a plan for how the study of mathematics could become a useful tool in order to investigate, critique and then affect change. He suggested that on a political level mathematics education within societal frameworks could transform the realities of individuals and that the context of that learning mattered at the most foundational level. “It has long been recognized that neither education systems in general nor mathematics education in particular is neutral in terms of learners’ positioning with respect to class, gender, “race”, ethnicity and global position” (Povey & Zevenbergen, 2008, p. 5). Gustein wanted to draw attention to the qualitative differences that rise out of schools that exist as more than just a pipeline to workplaces or adulthood. He contrasted two diametrically opposed educational contexts—Freire setting of a school, where the notion of “performance standards” or privatization would have been unheard of, with the current westernized urban learning environment that had neoliberal nuances. Gustein believed that a key way to reinvent the mathematics classroom, in order to align with a more culturally aware society, was to identify social contradictions in people’s lives and then use mathematics to solve them. Mathematics could be the tool, based on political-pedagogical projects, projects that could be directed by the individuals’ realities and the realities of the communities where they lived. Gustein was proposing that the use of mathematics as a way to identify, and one day even address, the dominance and suppression of some cultural groups by others. Mathematics would no longer need to be a passive subject that students were subjected to but rather could become an active social issue for students to be entrenched within.

Morgan (2015) believed that curricular development and pedagogical influences were “not arbitrary but (rather) reflected the historical conditions under which (they were) constructed (p. 11)”. Gustein (2012) would have agreed that learning in mathematics should and could be far from arbitrary. Povey and

Zevenbergen (2008) acknowledged that the context in which learning occurs in mathematics had a significant effect not only on what was learned but also by whom was doing the learning. Gadotti's work in 2017 added to the discussion underlying the conviction that knowledge was emancipator; that through learning individuals and the societies they existed within would have the power to become sovereign entities. Gadottimused that the key question in teacher leadership should be "what should a teacher be *like* in order to teach?" rather than "what should a teacher *know* in order to teach?" Researchers were beginning to line up, recognizing there was a need to further explore the role of mathematics as a learning device within a social construct.

### 5.1 Leading Change

In 2011, Kurt Stemhagen decided to study exactly what impact beliefs about teaching and learning of mathematics had within a broader societal context than just the classroom. The study looked at the teachers' specific beliefs connected to the nature of mathematics, the nature of teaching and learning, as well as their own perception of their teaching efficacy. Stemhagen's study found a strong correlation between teacher practice and underlying philosophy, which the researchers found particularly interesting considering there was little or no attention given explicitly to philosophy of mathematics within mathematical education programs. The essence of the study supported the notion that learning was not something that could happen without context; in order to construct new ways of learning it was not enough to simply teach new practices, there needed to be a deliberate intention to attend to relevant beliefs (Stemhagen, 2011).

The findings of the Stemhagen study supported what other researchers had been saying about the significance of the perception of external influences on both teaching and in turn learning (Burstein, 2003). Burstein's (2003) study identified that teachers who had undergone formal math-specialist training were more likely to identify with constructivist philosophies and pedagogical orientations and were more likely to possess positive efficacy measurements within the mathematical learning context. The implications of these findings were considered significant, especially when linked back to the questions about who was making decisions and why those decisions were being made. If the study showed that instructors with more "formal" training were choosing different pathways for learners than individuals with less training then it would make sense that stakeholders in public education with little or no higher formal level training may have a very different view of what was important for mathematics programs. The notion that educational inequalities may lead to other forms of inequalities, including social and cultural inequalities, was not lost on Stemhagen (2011) nor Gadotti (2017). In order to eliminate educational inequality however, there was growing pressure to better understand the political need for government that would care not only about quality education but also about the kind of quality education needed beyond just a service or a commodity in its strictest sense (Burstein, 2003). In addition to concerns about limited educational background of political influencers, some researchers were drawing attention to the fact that mathematical ideology could sometimes be more heavily swayed by a few educational leaders as opposed to having a base in scientific studies of pedagogy and actual

best practice (Geary, 2002). In order to fully appreciate the importance of effective curriculum and practice, Geary (2002) identified that decision makers needed to more fully appreciate how foundations of ideology could affect both the design and the direction of learning. As an example, in the Stenhagen (2011) study there were concerns raised that the school district might not even allow such an investigation since the focus of the research would have no direct connection to standardized test scores. When policy and planning were so strongly connected to external influences, the concern that the only practice given consideration might be what is mandated by those external drivers, could be a real threat to balanced decision-making. Who would influence the influencers was a critical part of the knowledge equation and despite decades of research in mathematics including, significant financial investments in research and professional development, “math education... remain[ed] resistant to systemic change” (Allen, 2011, p. 1). The politicized “math wars” seemed condemned to rage on.

Researchers such as Allen (2011) believed that the key to moving beyond the gridlock was the power dynamic indicative of politics. In order to push through the stalemate, leaders would need to be able to key in on the idea that the role of preparing students for democracy within mathematics was to use mathematics as a tool for learning about democracy. Allen was not alone in that thinking, and researchers began to work towards a better understanding of knowledge as a product of situations and that mathematics education was in itself a political activity (Povey & Zevenbergen, 2008). Current dominant conceptions of understanding seemed to legitimize that learning happened best within a social setting when a cultural and political framework were attached to it. Acknowledging that “whose voice counts, whose knowledge is deemed legitimate” (Povey & Zevenbergen, 2008, p. 1) changed depending on the political influences, Allen and other mathematical researchers began calling for even better understanding of the unique role mathematics could play in preparing students for a democracy both literally and figuratively.

## **6. Future Implications-Mathematics as a Solution**

“Math is as old as man itself” (Abudakar, 2017, p. 1) and it is no secret that societies have used and developed mathematics in order to cope with every aspect of survival. Without mathematics, societies would simply find themselves unable to evolve but while there is an abundance of research that explains the usefulness of mathematics in enhancing science and technology there is still a lack of research that analyzes the usefulness of mathematics in creating thriving societies (Ernest, 2005). To better understand how mathematics can be used, as more than just a contrivance of arithmetic, means a continued push towards diversity of mathematical practices and purposes (Bush, 2016). Mathematicians already know how to use math to solve science and technology problems but how to effectively use mathematics as a “weapon in the struggle for justice” (Gustein, 2012, p. 43) is still evolving. The growth of professional studies, within mathematics education, however does continue to improve. Providing research-based routes for mathematics’ leaders and practitioners to enhance research skills and knowledge, will in turn lend itself to growth of areas of interests (Gustein, 2012).

The key is expansion, not replacement, to find balance, so that the work of scholars who have been contributing the counter-narrative in mathematics have a place to add both academic and political voice. Mathematical leaders need the time to explore, and the patience to realize, that there is a continuum of pedagogy when creating critical mathematicians. The complexity of the challenge is not lost on leaders who understand that preparing future citizens to take a critical view of their lives will take more than attention to expanded mathematical applications and modelling; attention will need to be given to the importance of involving political issues and questions of ethics (Sanchez & Blomhoj, 2010).

Educational leaders and political entities also need to continue to contend with issues that emerge due to technological growth and globalization issues surrounding education (Klein, 2002). Social structure changes, expanding student numbers, changing access to educational domains, and demands combined with reduction of public resources often send school systems into a state of instability where alternative approaches to education are actively sought out and embraced, for social as well as economic reasons. Educational systems also need to acknowledge and create strategies to deal with growing demand connected to resistance of “too much” structure that some perceive exist in traditional formal education classrooms (Ernest, 2005). Home-based on-line learning, “de-schooler” movements, and the trend towards “personalized learning” are examples of individuals within a society finding ways to follow personal ideology rather than being a part of a system that does not speak to them or for them. Systems of education will need strong leadership to navigate uncharted territory; recognizing the important role education ideology has in setting the tone of a society without trying to monopolize that social control.

The broad societal or macro-social forces of politics can sometimes overtake the more micro-social forces within education, leading to rifts and then shifts in social structures as well as knowledge structures (Mitchell & Boyd, 2001). Evolutions in educational curriculum and practice can be more than just theoretical and political responses to shifts, educational change can shift the very nature of social structures. “All politicians and academicians whose heads are in clouds or buried in sand must pay more attention to the real world” (Pogge, as cited in Aydin et al., 2009, p. 3538). Accepting that the world stage no longer allows for educational systems, including mathematics, to avoid the responsibility of including critical analysis of socio-political issues in learning is a huge task for leaders at all levels. Mathematics needs to be an active participant in democratic processes, processes that require the inclusion of ethical perspectives as part of responsible learning (Povey & Zevenbergen, 2008). Explicitly analytical mathematical theories and techniques provide the tools for learning that societies require as they continue to thrive and grow; implicitly critical mathematical discourse and action become the weapons of learning that leaders need to use in order to create societies that are both just and knowing.

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