# Integration of Technology Enabled Education in Learning: a Comparative Study of the Influence of Learning Standards in the U.S., Japan, Singapore, and Finland

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***Abstract***

This paper examines how technology enabled education (TEE) can be successfully integrated into the classroom by questioning whether national learning standards either incentivize or deter the adoption of TEE. For this purpose, we investigate practices and policies in 1) the development and implementation of learning standards in curriculum, teaching, assessment, and professional development, and 2) responses to these standards in the U.S., Japan, Singapore, and Finland. The adoption of the Common Core State Standards in the U.S. in 2012 has led to a first set of common national standards for American education. In Japan, Singapore, and Finland, national standards have been in place for decades with some modifications as a result of series of educational reforms. In particular, the paper discusses the following: the introduction of "integrated learning" in 2000 in Japan, the "Teach Less Learn More" (TLLM) policy announced in 2004 in Singapore, and the decentralization process that gave more autonomy to local authorities during the 1990s in Finland. Despite differences in the socio-economic, political, and cultural structures of the three countries, the three countries are trying to give more autonomy to teachers and local authorities in implementing their educational policies for national learning standards. Thus, a comparison of these three countries and the U.S. shows a sharp contrast in how they address national learning standards. By viewing education as a complex socio-technical system that requires a holistic examination in specific contexts, the paper investigates both effects and limitations of adopting learning standards in Japan, Singapore, and Finland, and illuminates potential unintended consequences that need to be considered for their development and implementation in the U.S. Further, once we have clarified the factors and conditions that influence the adoption of learning standards we draw conclusions about how these factors influence the adoption of TEE in each country. Through the comparisons and contrasts of the practices and policies on learning standards in the four countries identified above, the paper attempts to offer recommendations on how to implement rigorous standards that also encourage the adoption of technology enabled education.

## Introduction

The adoption of national learning standards has become the most common method for attempting to improve a country's educational outcomes. Countries have had varying levels of success; some countries, such as Finland, have had their international ranking on comparative assessments such as PISA skyrocket and other countries, such as Japan, have declared their changes failures and seeking for an alternative way to reform education. We examine four cases, The United States, Japan, Singapore and Finland, and drawing from primary and secondary sources in each country, supplemented by interviews of educators in the United States and an ethnographic study of an elementary school in Japan, we come to conclusions about what factors determine the success or failure of each reform.

At the same time, educators around the world have become increasingly excited about the promise of Technology Enabled Education (TEE). The range of TEE is incredibly diverse and can be delivered in the classroom for a fraction of the cost of other educational materials. Most excitingly, TEE can allow the adoption of new pedagogical techniques, such as Blended Learning where students are exposed to both online resources and in-class teachers in concert and the Flipped Classroom, where students view the "lecture" as an online video at home which frees up time in class to conduct exploratory problem solving. We investigate the impact that national standards have on the adoption of TEE.

## A Case from the United States

Though not implemented yet, the adoption of national learning standards has been a long time coming. As articulated in large national reports such as the Opportunity Equation (Carnegie Corporation), adopting national learning standards solves numerous problems all at the same time. Learning standards, though not used directly in the classroom guide the design of curriculum, instruction, and assessment at the same time (as articulated by the NRC, 2005). For years, changes in curriculum were accompanied by difficulties with assessments, changes in pedagogical methods were difficult because of the curriculum, and changes in assessment methods were difficult pedagogically. When designing learning standards, Achieve, the organization responsible for designing both the Common Core State Standards and the Next Generation Science Standards, considered the criticisms of all three so that these standards could solve all problems simultaneously. Since the Common Core State Standards have not yet been fully implemented, and the Next Generation Science Standards are not even in their final form, we have used interviews with teachers, principals, and state administrators to draw conclusions.

## Curriculum

There are two main criticisms of the curriculum used in US schools: it is too broad and there is no common curriculum across districts or states. The first concern, over the breadth without depth, is often referred to as a curriculum that is "a mile wide and an inch deep." (Schmidt, Houang and Coogan) Unlike many top performing countries, the curriculum in the US contains so many topics that teachers have to spend only a small amount of time on each topic and can't go into a deep examination of any of the topics. Further, the lack of a common curriculum creates its own problems. Since each state and even district sets its own curriculum materials and lesson plans are not usable in many other classrooms. A national curriculum would tackle this problem, with materials being sharable across all different districts.

We have found that most teachers, principals and administrators concur that these standards are on the right track towards getting rid of the "mile wide and inch deep" curriculum. However, in order to make this shift, it follows that certain content must be removed to allow greater time spent on other topics. Some teachers are concerned about this shift, especially in the English and Language Arts, where a focus on non-fiction literature has met stiff resistance. (Ujifusa, 2013).

**Teaching**

Policymakers are increasingly concerned about the lack in progress towards teachers improving their instructional methods. Reforms after reforms have moved through schools in the last 30 years, and yet teaching pedagogy hasn't changed since the 1960s. Teachers interviewed, on the other hand, cite frustration at their inability to improve their teaching when there is such a large breadth of material to be tested on standardized assessments.

It is too early to see if significant improvements in pedagogy have come from implementation of these new standards, even in pilot classrooms. From our interviews, many educators explain that this is simply the result of the short timeframe of the implementation process. Teachers are spending so much of their time educating themselves about the new standards that they have no time to adopt new teaching practices as well. They have reported, however, that they are able to spend more time on the in-depth activities and no longer feel as much pressure to race through learning objective after learning objective.

**Assessment**

Over the last 15 years, there have been large changes to the assessment mechanisms in the United States. The No Child Left Behind act institutionalized large-scale standardized testing in all schools and mandated that schools with consistently low test scores undergo drastic measures to improve them. (NCLB, 2001) However, teachers and now a majority of the population are increasingly vocal about the downsides of "teaching to the test," where teachers only teach the facts that will appear on their standardized tests because of the high stakes attached to these exams (Rose and Gallup, 2007). While the public is not willing to do away with standardized tests (and accountability) completely, they are interested in improving these tests with improved technologies

The two large assessment consortia, PARCC and SBAC, and are running into numerous problems, and are thus much behind schedule. Alongside aligning these new assessments to the CCSS, they are also attempting to develop assessment techniques that move beyond the typical multiple choice questions that students are all so familiar with. Using new computerized assessments, these tests aim to ask follow-up questions based on student responses to determine better their understanding of the concept. However, this type of "deeper" assessment turns out to be even more costly and time consuming than experts predicted, and there are doubts that these new assessments will be complete in time for the full adoption of CCSS next year.

**Professional Development**

The bulk of the concern from both administrators and principles with the implementation of CCSS are with the professional development necessary. The Professional Development system in the United States is exceptionally varied; with some programs being very effective, and the vast majority being only marginally affective (Wilson, 2010). Most teachers interviewed did not think well of professional development, and because of their past experiences with ineffective professional development, they tended to assume new programs would also be

ineffective. Yet, professional development must carry the weight of educating teachers both about the standards themselves as well as new pedagogical techniques for improving their instruction. However, there has been almost a singular focus on the part of administrators and principles in providing high quality professional development for to help implement the standards well.

**Technology Enabled Education**

Currently in the United States, there are a plethora of opportunities for students to use technology enabled education; from full time virtual schools, supplemental online courses to coupling digital instruction with face-to-face instruction. In 2010, 1.5 million students were using online or blended learning instruction, with more using these tools every day (Education Week 2011). However, the use of technology varies across the country.

One of the largest barriers to more teachers adopting TEE is the lack of unified national curriculum. When every state, and even district within each state, has a different set of standards developers are at a loss about what content to create. Most states have developed guidelines for the use of technologies to supplement technologies and have moved away from simply using technology to deliver content, but had previously done little to align these requirements to others states (ACT 2004). One of the most compelling reasons that states adopted the new CCSS and NGSS was the hope that common standards across the country would allow the sharing of resources, including TEE. Many teachers have been critical of large textbook publishing companies for claiming alignment with the new standards without adapting the content (Gerwetz, 2012), which serves both as a warning to TEE content creators to not follow the same path. However, this presents an incredible opportunity for TEE providers to establish themselves as a credible and reliable resource for standards-aligned material during the time when every school district in the country is instead evaluating new materials rather than being locked into the materials they have already sunk money into.

Finally, TEE will be able to harness the current technology infrastructure, which has recently undergone major improvements, to deliver their content. The federal government has invested heavily in providing broadband internet connections to schools that might not otherwise be able to afford it (US Department of Education).

**A Case from Japan**

Japan has a centralized education system administered by the Ministry of Education, Culture, Sports, Science, and Technology (MEXT). Compulsory education in Japan requires nine years, including six years of elementary school and three years of junior high school. Although high school is not compulsory, approximately 96% of Japanese students complete high school (with approximately 2% dropping out every year). To enter high school, students take an entrance examination at the end of the third year of junior high school.

In Japan, "integrated learning" was gradually introduced as a new course for students ("integrated studies") in 2000 as a part of a reform for "relaxed education" with fewer courses (2002-2011, 2012, 2014). The reform for more relaxed education originated in the 1980s from concerns over "cramming education," which was regarded as the root cause of school violence, bullying, and drop-outs. Many associate the beginning of this reform with the adoption of "integrated studies/learning" under the goal of creating the "zest to live" (*ikiru chikara*), "the ability to learn and to think independently" (Tsuneyoshi 2004:369) among students, not just cramming for exams.

**Curriculum**

The implementation of "relaxed education" and corresponding national curriculum in 2002 reduced the amount of the curriculum content and instructional time by 30% (Tsuneyoshi 2004: 388). As Japanese students' results on international achievement tests (such as the PISA and the TIMSS) worsened in 2003, MEXT announced the failure of the changes. However, not all education scholars in Japan agree with the Ministry's assessment, saying that this was too soon to evaluate the effects of the reform. The "relaxed education" ended in 2008 with more content and instructional time than the "relaxed education" but less than the previous amounts of content and instructional time. The amount of time spent on integrative learning decreased, while that spent on math and science increased by 18% and 23% in primary and middle schools, respectively (Bennesse). Although the new curriculum puts an emphasis on "zest for living" (*ikiru chikara*), MEXT states that the 2008 courses of study emphasize acquiring basic knowledge and skills, nurturing thinking abilities, judgment formation, and self-expression (*shikoryoku, handanryoku, hyogenryoku*). Accordingly MEXT has implemented "integrated learning" across courses, without allocating hours for this as a course, but by adopting a perspective that enables teachers to design courses that attain the goal of integrated learning, such as developing critical thinking and communication skills. (Robert Fish, Asia Society).

**Teaching**

Despite the effort to change instructional methods through policy change, Japan has not seen major change in pedagogical method as a result of the new curricula. Due to the revised curriculum in 2012 that adds more content and instructional time, many teachers are struggling simply to keep up with the demanding schedule: approximately 40% of those teaching reading and almost 30% for math thought they were behind their annual schedules (Benesse, 2012). Students have been found to communicate and explain more effectively but, at the same time, more children were reported to be "tired" or "cannot keep up with classes." In addition, 40% of teachers agreed that a gap between those high-achieving and low-achieving students was widening (Benesse 2012). The widening gap of students' academic achievement based on a social class background has been a major topic of academic debates since the introduction of the "relaxed education." It has been suggested by scholars such as Kariya, *et al* (2002) and Mimizuka (2008 from Benesse 2007-2008). As it was left to each teacher to design effective lessons for "integrated study" courses, teachers' ability and students' motivation influence the learning results.

**Assessment**

As Howard Gardner, the author of Multiple Intelligence, says "it's no good to have child-centered learning and then have the same, old multiple-choice tests that were used fifty or one-hundred years ago." In changing the pedagogy and instructional materials, the assessment system has to be revised as well. Out of this concern, university admission offices now offer an entrance examination that consists of high school grades, an essay, and an interview instead of written exams. This is an initiative to create diverse assessment standards under the guidance of the MEXT with a goal not to "teach/learn for the test". However, as the quality of students is reported to be worsening with this system, the effects of this system need to be examined. There is still a large emphasis placed on the entrance examination to go on to high schools and colleges, and as such, teachers at junior high and high schools pressured to teach to the test. Though some of them may be interested, teachers cannot freely experiment with integrated

learning exploring higher learning skills. To adapt to the new curriculum, entrance examinations need certain modifications to reflect the learning results of "integrated learning" (such as higher-learning skills).

**Professional Development**

Under the current system, teacher training in Japan is multi-dimensional, continuous, and systematic at the national, prefectural, and more local levels. Among these training programs, induction training for newly appointed teachers for a year and the training program for teachers with 10 years' experience are mandatory. Under-qualified teachers take special training programs. In some extreme cases, teachers who have not proven their competence have been dismissed (Fujita 2007, 43-45). Overall, teacher preparation and qualifications are regarded as being adequate (Ingersoll 2007; Fujita 2007). However, MEXT reported in 2005 that instructional ability of teachers in integrated study varies from one teacher to another, and that the improvement of their instructional skills is listed as a future goal. As there are no textbooks nor guidance for the integrated study course as other subjects, teachers' creativity and planning ability are required to provide effective and meaningful "integrated learning" class and quality education (MEXT 2005). Despite generally strong pre- and in-service professional training, Japanese teachers were still unprepared to implement the new curriculum.

A major element of this strong professional development is the practice of Lesson Study. Lesson Study is the collaborative planning of a high quality lesson by a small group of teachers, usually four or five. Though the byproduct is a high quality lesson that can be shared by others, as implied by the name itself, the value for teachers comes through the reflective and self-critical process of developing these lessons. Through the iterative process, individual teachers take on the role of reflective professional researcher and can observe their own actions and the actions of others more objectively (Roberts 2010). Instead of being lectured at as in most typical professional development programs, teachers practicing Lesson Study are immersed in experimental pedagogical methods. This allows teachers to see the strengths and weaknesses firsthand and construct their own understanding of how to use these methods most effectively (Lewis & Tsuchida 1998; Lewis, Perry & Hurd 2004; Fernandez 2002).

**Technology Enabled Education**

Much of the focus in Japan on ICT has been in equipping schools with technology, with the Japanese government has committed to equip one device per student at school by 2020. As of March 2010 Japanese schools have one computer per 6.4 students, which is significantly less penetration than the one per 3.8 students in the US in 2005 and one per 3.6 students in UK in 2009. The "IT New Reform Strategy," established in 2006, aims to equip one computer per 3.6 students (MEXT 2011). 76% of primary schools, 69% of junior high schools, and 37% of high schools were equipped with electronic blackboards that can be connected to a computer for writing and drawing on the screen. However, this technology is not spread evenly amongst all the local prefectures. In Kagoshima Prefecture, 1 computer was shared by 4.5 students, while 1 computer was shared by 8.3 students in Saitama Prefecture.

There have also been effective efforts to train teachers to use these technologies. The IT Headquarters of the Japanese government proposed "i-Japan strategy" in 2009 to train all

teachers in using ICT for classroom instructions by 2015. Currently, 62% of teachers have the ability to use digital media for teaching (Asahi Newspapers, December 7, 2011).

Further, the widespread practice of Lesson Study would make the adoption of TEE especially effective. Each teacher has developed a large number of exemplary lessons through the collaborative lesson planning process which can be shared with other teachers around the country. Further, because of the strong national curriculum, each lesson that has been planned is easily transferable to every other classroom in the country. These factors suggest that by collecting these exemplary lessons an extensive database could be created with multiple modules on every single lesson taught in the country, which would undoubtedly free up teachers' time from extensive daily planning.

However, Japanese policymakers have only focused on equipping and training teachers with ICT and have not been open to broader changes in school structures, funding and rewards systems or pedagogy that would encourage teachers to adopt TEE. Japan's traditional test-centric pedagogy of a "hierarchical flow of information from 'knowers' to 'nonknowers'" is often not open for modern uses of TEE, such a project-based learning for the development of skills such as critical thinking (Bachnik, 2003). There is little chance this will change: in *The Education Reform Plan for the 21st Century* published by MEXT in 2001 there is only one small mention of how students will use technology in the classroom and no discussion of how school culture might be changed to one more open to TEE (Vallance, 2008). Without extensive changes of the context that the teachers work within, there will be little progress towards to adoption of TEE, despite having teachers well equipped with both devices and training.

**A Case from Singapore**

Although the academic achievement level of Singaporeans is known to be high compared with other countries, Singapore only implemented its compulsory education system in 2003. In addition, the length of their compulsory education is only six years (Jason Tan 2010). Students receive six years of primary education, and four to five years of secondary education, followed by two years at junior college, polytechnic or the Institute for Technical Education (OECD 2010).

After primary education, there are 4 tracks of secondary education lasting 4 to 5 years, followed by 2 to 3 years of pre-university education. Students take national examinations after each stage of school. The first exam, Primary School Leaving Examination (PSLE) is given at the age of 11, in the 6th grade. In Singapore, the educational emphasis had been on rote memorization, rather than ability to think critically. The Ministry of Education (MOE) introduced a greater focus on creative and critical thinking and on learning for life-long skills, rather than simply learning to excel on exams. This process began with the 1997 reform, "Thinking Schools, Learning Nation" followed by the 2004 "Teach Less, Learn More" policy. For this vision, the Ministry of Education designed to tailor education to provide more flexibility and choice for students and transform the educational structures, such as to move away from the centralized top-down system to give more autonomy to local schools to ensure new forms of accountability given to each school. Each school sets its own goals and annual assess its progress (OECD 2010, 163).

**Curriculum**

TLLM was to open up more "white space" in the curriculum to engage students more deeply in learning. In 2005, MOE announced that the content was reduced by 10-20% (J. Y. Ng

2012). In 2005, the MOE clarified this philosophical statement to mean transforming learning from quantity to quality: "more quality and less quantity" in education (J. Tan 2009; P. T. Ng 2008; Darling-Hammond 2010). With the content deduction of the curriculum undertaken with care, students remain well prepared for post-secondary education and continue to meet international standards. The curriculum focuses on the fundamental of effective teaching to engage students with a holistic understanding of the content beyond preparing for test and examinations (Ng 2012). Due to this policy shift, more scholars report that schools are trying to engage students with learning, rather than with teaching. However, learners were still seen as too passive, overloaded with content, driven to perform, but not necessarily inspired (Ho Peng, interview at the Asia Society).

**Teaching**

Traditionally, the emphasis of Singaporean education had been on rote memorization. TLLM promoted different learning paradigm, which was less dependent on rote learning, repetitive tests and instruction, but "more on engaged learning, discovery through experiences, differentiated teaching, learning of lifelong skills, and the building of character through innovative and effective teaching approaches and strategies." (Ho Peng, interview, Asia Studies)

Every two years, the MOE evaluates schools' "implementation and response" to the "Teach Less Learn More" policy. Due to this system, there are more increased levels of professionalism amongst teachers. It has been observed that didactic instruction in the classroom has been reduced and students have gained more confidence (J. Y. Ng 2012). The introduction of teaching assistants in the classroom, known as Allied Educators, has also helped to support the focus on quality teaching and learning. (Ng 2012)

**Assessment**

The education system in Singapore is based on meritocracy. Academic grades are considered objective measures of students' abilities and efforts, irrespective of their social backgrounds. Many students are pressured by their parents and teachers to do well in their studies. The Singaporean government provides grants to community bodies to offer tutoring for low-income families.

Despite these reforms, it is reported that there was no change with assessment. Teachers routinely feel pressured to "teach to the test" and end up relying on rote learning (J. Y. Ng 2012). There are however alternate tracks: students who intend to go on to college can skip O-level exams by entering Integrated Programme Schools, which combines Secondary and JC education without an intermediate national examination. At these schools, students can engage in broader learning experiences that develop their leadership potential and capacity for creative thinking (OECD 2010, p. 165)

**Professional Development**

Strengthening its teaching force has been critical to the success of the Singaporean education system. MOE has been trying to build up a strong qualified teaching force through a process of careful and detailed planning, aggressive teacher recruitment, comprehensive training and effective teacher retention, both quality and quantity (CPRE 2007, p. 71). All teachers are hired by MOE from the top one-third of each cohort. All teachers and trainee teachers receive pre- and in-service training at the National Institute of Education (NIE). NIE works symbiotically with MOE to give advice on hiring of the teachers. Trainee teachers are paid as well, and jobs are guaranteed with the completion of pre-service training at NIE. Teachers do

not need an undergraduate degree for primary teaching. As NIE and MOE work closely in hiring, establishing standards for contents and pedagogy, there is no issue of unqualified teachers. More and more school leaders (principals, vice-principals) have a master's degree (CPRE 2007, OECD 2011 video).

The MOE has also provided resources and support for schools, including Professional Learning Communities (PLCs) in schools and Centres of Excellence to "facilitate sharing of good teaching practices among teachers and schools." However, it is also reported that teachers are under high levels of stress, as the country is shifting towards a more knowledge-based economy. The reform to facilitate teaching is placing more pressure on them. In addition, the sociocultural practice of competition is wearing upon them (Handbook, Ch. 4).

**Technology Enabled Education**

Use of ICT in education in Singapore began in earnest with the First Masterplan (1997-2002) with a goal to provide the basic ICT infrastructure and to equip teachers with the basic levels of ICT competency. It aimed to allow students to have computer usage for 30 percent of their curriculum time in fully networked schools and at a computer to pupil ratio of 1:2 (Aguirre 2012, Pak Tee Ng in Rubin 2012). Following this, the Second Masterplan (2003-2008) was announced to create an effective and pervasive use of ICT in education (Aguirre 2012). This encouraged teachers to use ICT in teaching and learning (Dr. Pak Tee Ng in Rubin 2012). The Third Masterplan (2009-2014) was implemented to continue the previous plans' philosophy and did not make major changes to ICT policy. (MOE 2008, Aguirre 2012, Pak Tee Ng in Rubin 2012). In 2007, the student to computer ratio was 6.5:1 in primary schools, 4:1 secondary schools and junior colleges, and each teacher was equipped with a notebook computer. ICT was integrated about 30% of the curriculum time (Koh 2007).

The MOE has created a differentiated professional development focused on how ICT can help students learn better, and provides a training program to develop a group of practitioners in their ICT-related pedagogies and coaching competencies, with a goal to place about 4 such ICT mentors in each school (Pak Tee Ng in Rubin 2012). Schools have supported this effort with the Next Generation Broadband Network (NGBN) providing ultra-high speed wireless connectivity (Aguirre 2012, Dr. Pak Tee Ng in Rubin 2012).

**A Case from Finland**

Compulsory education in Finland is 9 years, from the age of 7 until age 16. Overall, 98% of children attend preschools (universal day care is provided from 8 to 5 months of age since 1990; 1 year of preschool/kindergarten is provided at age 6 since 1996), but early childhood education is not mandatory. The completion rate of compulsory education is 98%. If students score multiple failing grades during that time, they may have to repeat the year (with pupil and parental consent). All school-related expenses, such as school healthcare, lunch, books and materials, and school trips are free during the first nine years. At the age of 16, students choose whether to undergo occupational training to develop vocational competence or to enter an academic upper school for university and post-graduate professional degrees. Upper secondary schools are 3 to 4 years long. Finnish class sizes are small, with approximately 20 students per class, and they further divide students into groups (Nishijima 2005). Students stay with same teachers for several years, and there is no ability-based tracking.

From 1970 to 1985, Finland centralized education standards and adopted their first national standards. Then since 1990, Finland has focused on decentralizing power, giving teachers control over their own teaching methods and only having a framework curriculum. The national curriculum is set as broad guidelines for teachers, and more trust is placed on teachers as professionals, who all have a master's degree. These teachers are the top 10% of the graduates, and they have a status as high as doctors and lawyers.

How the Finnish understand education and learning is different from what has been encountered in Asian countries. They have a philosophy of equity and equality, and they believe in a high degree of personal responsibility and individuality. They emphasize caring and cooperation with others, rather than competition. There is more focus on "learning to learn" (or critical thinking) than on learning the subject matter. Pasi Sahlberg (2010) says in the Hechinger Report that "the important thing is ensuring school as a place where students can discover who they are and what they can do. It's not about the amount of teaching and learning." In addition to free education, free school lunch and health care, they have a culture and philosophy that enables students to be motivated towards learning and the student-centered learning style. According to Sahlberg, this educational environment was the result of the reforms of education and social systems in the 1970s.

**Curriculum**

Finland has a National Core Curricula for Basic Education and Local Curricula. This document created 1) a loose conceptual framework describing intended experiences, rather than content; 2) schools were invited to design their own curricula (though not required to do so); 3) increased flexibility and freedom of choice; 4) focus on a new conception of learning; and 5) support to schools for curriculum design (Sahlberg 2010). Many have suggested that this tight control was essential to the success of Finnish education, before gradually loosening once well-qualified teachers were in place (Tahka et al 2012).

Standards were the very first step in education reform in Finland. They used higher standards to influence teachers of all abilities to get on board. Further, and perhaps more importantly, high standards raised the interest of many students in higher education, eventually depressing the wages of a master's degree enough to allow Finland to require a Master's degree (OECD 2010).

**Assessment**

In Finland, there is only one standardized test at the age of 16. There are no state mandated tests every year, and assessments are primarily given both formally and informally by teachers. Further, students are not measured in comparison to others in the first six years. (Hancock 2011). No ability grouping, either, due to the notion of equity. Without creating high stakes tests for students as in Asia, Finland has achieved a high school completion rate of 93% and a high ranking in international achievement tests.

**Teaching**

The classes are designed so that lessons are based more on student input (60% student input, 40% teacher input); they focus on student-centered learning and let students discover concepts rather than teaching those concepts. The lessons are based on debate, and there is very little testing and homework. They employ technology for learning, with a strong emphasis on innovation and entrepreneurship. Debate-based lessons are also provided, and there is very little homework.

Teachers in Finland are currently more concerned with how to educate good students in a comprehensive school setting (interviews in Nishijima 2005). Comprehensive schools without ability tracking seem to work well for assisting low-achieving students, but they may not be effective for assisting students who are excelling (Okubo 2012). Therefore much of the professional development focuses on the enabling teachers to teach to groups of heterogeneous students.

**Professional Development**

A large part of Finland's success seems to come from their strong pre-service professional development program. A Master's degree is required for all teachers, requiring both in depth subject knowledge and general understanding of education principles and pedagogies. In addition, they have to demonstrate their knowledge and skills through writings and discussions in the examination to be hired as teachers.

In its economic, social, and educational policies, Finland places significant importance on collaboration and knowledge sharing (Information Science Advisory Board, 2000, p. 5). The educational policy is coordinated with this idea, and the Information Strategy for Research and Education was developed. It emphasizes the need to develop information society skills in all students, the building of open education and research networks, and the development of educational information products and services (Kozma 20XX).

**Technology Enabled Education**

With the large amount of local control, there is a wide range of technology use by individual teachers, but overall, technology use in Finnish classrooms is low. Teachers seldom involve technology in the classroom, and when they do Finnish teachers tend to use technology to support the same pedagogical styles they have been using, not to adopt new pedagogies. (Ramboll Management, 2006) Further, teachers have identified that interesting content available through new technologies will be what attracts them to use such technologies in the classroom.

Finland has the infrastructure to support the use of technology in the classroom with wide internet access and many computers in each school. However, the national guidelines in Finland regarding the use of TEE in schools are intentionally vague to allow teachers to guide their own classrooms and adopt new technologies as soon as they appear. While well-intentioned, this policy has allowed many teachers to avoid adopting new technologies and pedagogies in the classroom (Thayer, 2012)

**Discussion**

Each of these countries has clearly taken a different path when attempting to implement new national standards, however there are lessons to be learned through the comparison. All of these reforms have been centered around the recognition that education systems are not just teaching students lists of information and that they are also equipping students with necessary skills (such as critical thinking, creativity, etc.) and developing their interests in various subjects. Thus all four countries have centered their reform at least somewhat to require less content in their curricula in order to free up time for deeper investigation of various topics and new pedagogical methods.

First of all, from the implementation of these standards we can see that there needs to be a coordinated approach across the entire system. Assessment has to be based on students'

demonstration of skills rather than memorized facts. Without this, alignment with the assessments drives students and parents to demand rote teaching and learning in school or outside school, as is the case in both Singapore and Japan. Teachers must also be prepared to teach in new methods by professional development, both pre-service and in-service, or they will not be able to achieve the desired outcomes, as was seen successfully in Finland and Singapore.

Further, we can see teacher buy-in is essential for the success of reforms. It is clear that increasing the autonomy for schools and teachers encourages support for reforms, as is the case in Finland. Singapore is also trying to increase local autonomy by giving greater autonomy to schools and rewarding successful school for accountability. When moving from a centralized system to decentralized system, such as in Finland, the formal structure persists long enough to allow for effective dissemination of practices and information early in the implementation. Typically, the strongest advice networks for teachers are the informal bonds with other teachers, usually locally through their schools or over the internet, which are hard to break into. Local control in Finland and Singapore harnesses these informal connections instead of fighting against them.

Finally, policymakers need to consider how social structures and contextual factors drive change within the education system. Educational reforms are most effective as a part of all social reforms to create a sense of equity and sharing in society as was the case in Finland. Without these changes competition remains intense among students and parents and performance on testing is the largest incentive in education. As in the case of Singapore and Japan, teachers try to meet parents' expectations to teach to these tests. Small (Finland and Singapore) and homogenous (Finland and Japan) countries can also more easily adapt to local problems in implementation.

However, these lessons learned for the successful implementation of standards paint a bleaker picture for the adoption of technology enabled education. While introducing autonomy to teachers in Finland and Singapore has been successful for improving the educational outcomes it has proven to be a barrier for the implementation of TEE in the case of Finland. These tools are not disseminated easily through informal networks and few teachers besides those already interested in utilizing technology in their classroom end up using TEE. Further, without explicit encouragement or regulation, those teachers who do adopt TEE primarily use these methods to support old pedagogies.

Further it is clear that the success of TEE is directly tied to the professional development that accompanies it. Singapore has been able to utilize TEE most effectively because of the support given to teachers. For countries like the United States, with a professional development system that is largely seen as ineffective and over-tasked, TEE will need robust professional development alongside typically professional development. In most countries surveyed, there was little if any formal pre-service training regarding the use of TEE in the classroom, and each teacher was left relatively unprepared to adopt TEE.

Throughout the process of adopting new standards, there are points of leverage that might enable widespread use of TEE. As new assessments are being created to test the higher-order skills such as critical thinking and problem solving, test designers have created new psychometric tests involving, for example, the manipulation of computer models. The use of such assessments would naturally incentivize teachers to "teach to the test" using modern TEE tools. Further, many new standards documents, such as the Next Generation Science Standards in the United States, explicitly call for the introduction of new technologies in the classroom.

The adoption of new educational standards is never a predictable process. Even small changes in the education system can have resounding effects for teachers and students. A careful consideration of how to integrate TEE into the classroom, and subsequent inclusion in national standards, can incentivize the adoption of new pedagogical techniques using TEE. Most importantly, the lack of inclusion of TEE in standards, or an unclear or ambiguous policy, is a major hurdle set in front of the adoption of TEE.

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