Is Online and Blended Learning Cost-Effective?

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While online learning has existed at some level in both K-12 and higher education for over two decades, the last five years have witnessed an explosion of virtual and blended models of education (Watson, Murin, Vashaw, Gemin, & Rapp, 2010). The models vary in size and structure, ranging from state-run virtual schools such as the Florida Virtual School with 150,000 statewide annual enrollments to stand-alone schools experimenting with programs that fall somewhere between home schooling and traditional classroom education. Cavanaugh (2010) attributed the variations in models to “different policy and budget ecosystems” (p.22). In the current environment of fiscal tightening, many states, districts and individual institutions of education perceive online learning as a means to reduce overall costs, while simultaneously increasing learner access to educational opportunities (Foundation for Excellence in Education, 2010). However, few such interventions have been examined thoroughly under operational conditions to establish the all-in financial costs of online learning and weigh these against the benefits or effectiveness in terms of educational outcomes (Bates, 2005).

Cost-effectiveness (CE) analysis aims to facilitate efficient use of educational resources (Levin & McEwan, 2001). Given a target objective, for example, decreasing the high school drop-out rate in a district by 10%, CE analysis can identify the lowest cost alternative to achieving this objective. The process involves assessing the costs of various interventions that aim to reduce the drop-out rate and reviewing the evidence that the 10% reduction objective can be met. Alternatively, given a fixed budget, a CE analysis can identify the costs of each intervention and indicate which one is expected to decrease the drop-out rate the most.

With respect to online learning, there are two parts to the cost-effectiveness question. The first is whether online learning costs more, the same or less than traditional face to face classroom teaching. The second is whether online learning is more, less or equally effective in promoting positive educational outcomes for students. Administrators and policymakers are currently overly focused on the cost element and often carelessly substitute the word “cost-effective” for “cheaper” in references to the benefits of online education. Effectiveness is either ignored or assumed. Teachers and parents, on the other hand, are concerned about effectiveness. This paper will provide a brief overview of the existing research addressing each part of the question and subsequently focus on a particular blended learning intervention to illustrate in detail both a cost analysis and effectiveness studies.

To address the issue of costs of online education, the Center for American Progress surveyed 20 directors of virtual schools in 14 different states. The resulting report by Cavanaugh (2009) indicated an average annual cost of $4,310 per full-time online student in 2008. Compared with the NCES reported average per pupil expenditure in public schools for 2007-2008 of $10,297, the face value savings are staggering. However, while this comparison may seem attractive for states facing slashed education budgets, the services offered by traditional schools far exceed what is provided by such online schools. As Cavanaugh notes, traditional schools provide not just academic courses but also transportation and nutrition services, school counselors and nurses, college guidance, libraries, media specialists and resources, clubs, activities and professional development services. Decisions to replace traditional schools with virtual ones must factor in the costs of losing these services or providing alternate ways to access them.

In another study, Anderson, Augenblick, DeCesare and Conrad (2006) convened panels of online program providers to estimate the operating costs of virtual schools. The authors concluded that these costs, while varying from $3650 to $8300 per full-time equivalent student, are, on average about the same.
as those of regular brick-and-mortar schools when similar services are being provided, excluding transportation and capital costs. The authors acknowledged that these estimates need to be refined to be relevant to specific conditions in a particular state or district. In both this study and the Cavanaugh study above, cost estimates are based on self-reported information from online education administrators. Neither estimate represents the costs of a specific, identifiable intervention nor is there any attempt to balance costs against benefits or actual student outcomes.

Effectiveness of online learning can be measured in different ways. For some decision makers, higher test scores are the only meaningful measure of effectiveness of an educational intervention. For others, the aim is to allow students to learn more content and skills within a fixed amount of time. Another goal is to promote faster learning of a fixed amount of material to allow for speedier student graduation or promotion. At the high school level, the focus may be to increase the completion rate of a course or the school graduation rate. The latter is the aim of online credit recovery programs.

To date, very little rigorous research has been conducted with respect to effectiveness of online or blended education, especially at the K-12 level. The most significant recent study was a meta-analysis by Means, Toyama, Murphy, Bakia, and Jones (2009, Revised 2010) sponsored by the U.S. Department of Education. The meta-analysis included 99 studies comparing the learning outcomes in online and blended learning situations with traditional face-to-face learning. The study concluded that blended instruction is more effective than conventional face-to-face classes for older learners (undergraduates and adults). Pure online learning was found to offer a small advantage, again for older learners, although treatment conditions for both online and blended learning situations often included additional learning time, materials, and opportunities for collaboration. Positive effects were not found at the K-12 level, but this conclusion was based on only five studies that qualified for inclusion in the analysis.

To conduct a rigorous cost analysis of any educational intervention, Levin and McEwan (2001) proposed the ingredients method or resource cost method for identifying costs. By reviewing program documents, interviewing personnel involved in the development and delivery of the intervention, and observing the intervention in a typical field situation, the various components of a program are identified. These will fall into categories such as personnel, which often account for about 75% of the costs of any educational intervention; facilities; equipment and materials; other inputs such as insurance and electricity; and client inputs such as transport costs. Levin and McEwan’s general methodology was followed to estimate costs of School-of-One (So1), a blended learning intervention for math instruction. The costs were separated into up-front costs of developing the So1 technology platform and adoption costs, which would be experienced by schools deciding to substitute their regular math instruction program with So1.

School-of-One is a recent initiative of the New York City Department of Education. Initially piloted in 2009-2010 as an afterschool program, a summer program, and briefly, as an in-school alternative to the regular math program, it has now been fully integrated into the school day at three public middle schools to provide highly individualized daily math instruction for 1,500 students. Students spend 70 minutes a day in one of eight modalities: learning with software, independent work, peer tutoring, learning with a remote tutor online, small or large group instruction with a face-to-face teacher, small group collaboration, and integrated learning projects. Around 10 minutes daily are spent completing an individual assessment that allows a computer-based “Learning Algorithm” to determine how the student is progressing along a math skills map and what still needs work. Each student’s daily lesson plan or “playlist” is generated by the Learning Algorithm system and displayed on terminals as students enter the classroom.
Development costs for So1 are estimated at about $7,000,000 total over two years. An estimated $4,000,000 of this total was paid to an outside vendor to build a computer system that: houses 5,000 math lessons that can be completed and assessed online; tracks individual student progress and determines which skills still need mastery; and generates a daily playlist for each student. A panel of math experts developed a math skills map and reviewed 25,000 possible lessons in order to select the 5,000 chosen. The estimated cost of this process is $150,000. The 5,000 lessons were purchased from 50 different vendors and adapted for the So1 system at an estimated cost of $500,000. A team of 12 education and technology professionals worked with the outside technology vendor in developing the system and interfacing with schools participating in the pilots. The estimated total costs for these professionals are $1,200,000 per annum.

Annual adoption costs for a hypothetical New York City school using the So1 system are estimated based on a middle school of 480 students. It is assumed that four groups each of 120 students work with So1 for 70 minutes per day, five days a week for 36 weeks a year. The school employs four fully certified math teachers and two student teachers. It is assumed that these teachers would be employed at the school regardless of whether So1 is utilized, so the teacher cost of approximately $380,000 per year would not be specific to So1. Additionally, it is assumed that the school already has Internet access for all students and wireless connectivity. Any school adopting So1 that is not already wired would need to factor in costs of approximately $25,000 per annum for Internet access and $50,000 amortized over 5 years for wireless connectivity.

New costs that are directly associated with adopting So1 are estimated as follows for the first year:

- $200,000 in construction costs to open up space to accommodate 120 students with 100 laptops or personal computers. These costs are amortized over 5 years.
- $8,000 for teacher professional development in the use of So1 for one week prior to the start of the school year.
- $80,000 for a full-time in-house digital content manager to provide ongoing technical support and professional development and to interface with the So1 developers.
- $110,000 for hardware costs including 100 personal computers or laptops, four printers, one projector, and two 48” terminals for displaying student playlists. These costs are amortized over three years.
- $150,000 school-wide licensing charge from So1 for access to the Learning Algorithm, all content and provision of daily playlists.
- $10,000 in ongoing weekly professional development for the math teachers from a So1 developer.
- $324,000 for virtual tutors, assuming 15 tutors are engaged 4 hours per day, 180 days per year at $30.00 per hour.

These first-year costs are summarized in Table 1, which shows the cost of each component for the entire school of 480 students and the cost per student. The total cost per student is estimated at $1,217 although it should be noted that the virtual tutoring component is by far the largest cost, at $540 per student. If this option were eliminated, the cost per student would drop to $677.
Table 1. Estimated Marginal Costs of Adopting the School-of-One Program at a Hypothetical Middle School of 480 Students in New York City

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost per annum for school of 480 students</th>
<th>Cost per annum per student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction*</td>
<td>$40,000</td>
<td>$83</td>
</tr>
<tr>
<td>Initial professional development</td>
<td>$8,000</td>
<td>$17</td>
</tr>
<tr>
<td>Digital content manager/technology support</td>
<td>$80,000</td>
<td>$167</td>
</tr>
<tr>
<td>Hardware**</td>
<td>$36,667</td>
<td>76</td>
</tr>
<tr>
<td>School of One license</td>
<td>$150,000</td>
<td>$313</td>
</tr>
<tr>
<td>Ongoing professional development</td>
<td>$10,000</td>
<td>21</td>
</tr>
<tr>
<td>Virtual tutoring</td>
<td>$324,000</td>
<td>$540</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$619,000</td>
<td><strong>$1,217</strong></td>
</tr>
</tbody>
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* Cost amortized over 5 years
** Cost amortized over 3 years

Having estimated the cost of the program per student, the second part of the cost-effectiveness question is whether So1 has a large enough impact on student outcomes, compared with traditional classroom learning, to justify the extra costs. The currently available evidence is limited to studies of So1 pilots in summer school, afterschool, and briefly as an optional in-school alternative to the traditional math program. An evaluation of the summer school pilot found that 80 rising 7th graders who were exposed to So1 for four hours a day, five days a week for five weeks (a total of 100 hours or the equivalent of 4/5 of a regular year of math instruction) gained an average of 28.2% from pre-test to post-test scores (Light, Reitzes & Cerrone, 2009). Lack of a comparison group prevents determination as to whether this gain was greater than would be achieved by traditional teaching methods. Additionally, the summer program was highly resource intensive, employing 10 adult educators and three high school interns for 80 students.

During the 2010 school year, three middle schools invited students to opt into an afterschool pilot of So1 from February through May. A total of 600 students participated but an internal evaluation by The New York City Department of Education’s Research and Policy Support Group (2010) concluded that math test score improvements for So1 users, compared with the students who did not opt in, were only significantly higher in one of the schools. This latter school implemented So1 with all sixth graders as a substitute for the regular in-school math program from May through June, 2010. The evaluators of this implementation found no significant impact on math test scores for So1 users as compared with a comparison group.

In the case of School-of-One, cost-effectiveness would be best judged by determining the effectiveness of the full year in-school model and comparing this with the actual costs of delivering the program over that period. The inconclusive effectiveness evidence from the pilot program evaluations suggests that the estimated costs of $1,217 per student, above and beyond the costs of traditional face-to-face teaching, are not currently merited. In the case of virtual schools and pure online courses, significant costs savings are likely if student-to-teacher ratios are allowed to increase and if non-instructional services are eliminated. However, without rigorous documentation as to how learning outcomes compare with traditional situations, it will not be possible to claim that they are cost-effective.

References

Cavanaugh, C. (2009). *Getting students more learning time online: Distance education in support of expanded learning time in K-12 schools*: Center for American Progress.


**About the Presenter**

**Fiona Hollands** conducts cost-benefit and cost-effectiveness analysis of educational interventions at the Center for Cost-Benefit Studies of Education and does research and evaluation on the effectiveness of technology in education at the Center for Technology and School Change. She has a particular interest in assessing how interventions that have proven successful with disadvantaged students can be scaled up in a financially feasible manner. Fiona also teaches program evaluation methodology and policy analysis at Teachers College, Columbia University.

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