

Mobile Innovations in the Education Ecosystem¹

Innovaciones móviles en ecosistemas educativos

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Palabras claves

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Abstract

This paper shares macro-level perspectives drawn from business and engineering on the widespread efforts to bring innovation to education ecosystems. Significant shifts are occurring in the education marketplace: from content delivery technologies to video capturing and processing technologies. The changes involve a combination of large corporations and small innovative start-ups, for example, there is increased emphasis on engineering approaches to the integration of pedagogy and learning analytics into online education systems, more marketplace-based companies are surfacing, and global *edupreneurs* are building an array of skill-based training and workforce ecosystems. In short, it is highly predictable that the ways people acquire knowledge and learn new skills, evaluate competencies, and secure jobs will change drastically in the future.

Resumen

Este artículo comparte las perspectivas a nivel macro en los negocios y en la ingeniería sobre los esfuerzos masivos de los ecosistemas innovadores de la educación. Son notables los cambios en el mercado de la educación, en las tecnologías que generan contenido, las que graban video, las tecnologías de proceso, así como en las grandes corporaciones, y en las pequeñas compañías incubadoras. Por ejemplo, se ha hecho más ingeniería para integrar la pedagogía y el análisis del aprendizaje en los sistemas de educación online. Cada vez más compañías y edu-emprendedores están construyendo entrenamientos basados en las habilidades y en los ecosistemas de la fuerza laboral. Es predecible que las formas en que la gente adquiere conocimiento y habilidades van a cambiar drásticamente.

INTRODUCTION

We are going to present a high level overview of what is happening in the education space, of current and emerging trends and of the players who are active in the market space.

Several important tech companies have been founded by Stanford University students. Google was started by Larry Page and Sergey Brin, who received a startup check for US\$100,000 in 1998 from Andy Bechtolsheim,

another former student and co-founder, with Scott McMillan, of Sun Microsystems Stanford University Network (SUN). Yahoo was started by Stanford students Yari Yang and David Filo. In 1994, while fiddling with their computers in the Computer Lab, they created the URL (akebono.stanford.edu/yahoo) for their new company, Yahoo. Reed Hastings, a major proponent of internet television, who completed his master's degree in Computer Science at Stanford, founded Netflix in 1997.

Years earlier, Bill Hewlett and Dave Packard had graduated in electrical engineering from Stanford before going on to found HP (previously Hewlett Packard) in 1939. These are the kinds of students that have studied at Stanford and moved on to start global enterprises. The goal, for many of these students, filled with entrepreneurial spirit, is to end up in Silicon Valley, CA (United States) (Figure 1), to set up their own companies and to change the world.

1 This article is based on the lecture of Paul Kim presented in the forum "Strengthening Engineering Education with new Information and Communication Technologies" which was held at Universidad de los Andes on November 13th, 2013.

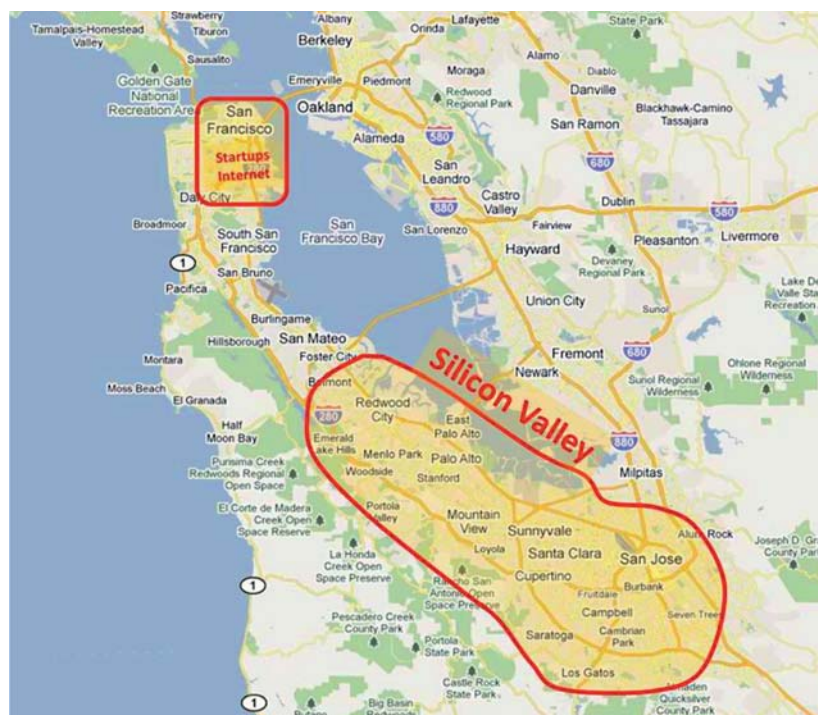


Figure 1. On the map, we can see that Silicon Valley, CA stretches down from San Francisco, all the way to San José (United States).
Source: (Rockies Venture Club, 2014) [Map of Silicon Valley, CA].

EDUCATION VENTURES

As we know, technology has been the major driver of economic development worldwide. There is an interesting sector that is riding on the back of growth in the technological sector: the education market. Globally, US\$4.5 trillion were spent on the sector in 2012 and it is projected that this will rise to US\$6.3 trillion by 2017. This market is growing rapidly, and involves a large number of companies including Blackboard and Canvas (Figure 2).

The education technology market can be divided principally into three areas: learning management systems, student information systems and content providers. In 2013, US\$1 billion was

invested in educational ventures. Kleiner Perkins Caufield & Byers (KPCB) invested US\$43 million in Coursera² and other companies, such as Udacity³, also received US\$16 million from Andreessen Horowitz, as did Lynda.com⁴, a company started by Lynda Weinman, who learned how to use PowerPoint and Excel before producing her own teaching videos back in the 1990s, and which is now worth more than US\$500 million. Open English⁵ is developing into a major company and has recently received a huge cash injection to facilitate its continued growth. K-12⁶ is another example; it has more than 150,000 students and has attracted significant investment in its 100% online high

schools programs. These are the companies that are up and coming in the market and their stories give us an idea of the levels of investment involved.

2U⁷ is one of a growing number of companies that help universities develop online course and has taken on responsibility for the development and roll-out of entire web-based courses. The confidence of venture capital in 2U is apparent from the fact that the company has received several and repeated investments, totaling some US\$ 26 million.

The rising learning management systems provider, Canvas, has also received several investments amounting to US\$30 million. Open English provides real time online English tutoring and has been financed to the tune of US\$65 million. Lumosity⁸ is a brain training application used by thousands of people and has received investments of US\$32 million. This, then, is a snapshot of what is happening in the education space, of the kinds of companies that have emerged and the investment they have received.

The buzz phrase of 2013, which many people are talking about, is Massive Open Online Courses, or MOOCs. These include Coursera, edX, and Udacity alongside a wealth of other providers. What contribution have MOOCs made to the space of education? Their impact has been profound, firmly establishing online education as a legitimate and noteworthy education option. Before the arrival of the MOOCs, online education was consistently criticized for providing an inferior, inauthentic experience that was unlikely to consolidate itself, or was at least destined to remain on the sidelines. But it has, in fact, emerged into the mainstream, and is clearly going to play a central role in future educational practices and scenarios.

2 <https://www.coursera.org/>

3 <https://www.udacity.com/>

4 <http://www.lynda.com/>

5 <http://www.openenglish.com/la/>

6 <http://www.k12.com/>

7 <http://2u.com/>

8 <http://www.lumosity.com/>

Knowledge	Market Size (2012)	Market Size (2015)	2012-17 Growth (CAGR)	Market Size (2017)
Global Market Size				
Global Education Expenditure	\$4,450.9 B	\$5,508.7 B	7%	\$6,372.5 B
K-12	\$2,227.0 B	\$2,624.6 B	6%	\$2,930.3 B
Postsecondary	\$1,495.2 B	\$1,883.5 B	8%	\$2,196.9 B
Corporate & Govt. Learning	\$356.6 B	\$449.3 B	8%	\$524.0 B
eLearning	\$90.9 B	\$166.5 B	23%	\$255.5 B
K-12 eLearning	\$16.6 B	\$39.0 B	33%	\$69.0 B
Higher Ed eLearning	\$48.8 B	\$95.4 B	25%	\$149.0 B
Corporate eLearning	\$25.5 B	\$32.1 B	8%	\$37.5 B
For-Profit Postsecondary	\$96.1 B	\$146.1 B	15%	\$193.2 B
Social Learning/Communities	\$1.0 B	\$2.9 B	40%	\$5.6 B
Child Care	\$200.0 B	\$266.2 B	10%	\$322.1 B
Edu Gaming	\$2.0 B	\$4.4 B	30%	\$7.4 B
Global Language Learning	\$115.0 B	\$198.7 B	20%	\$286.2 B
Global English Language Learning	\$63.3 B	\$123.6 B	25%	\$193.2 B
Test Preparation/Tutoring Market/Counseling	\$54.0 B	\$78.2 B	13%	\$100.0 B
For-Profit	\$590.9 B	\$952.2 B	17%	\$1,311.0 B
United States Market Size				
US Education Expenditure	\$1,432.1 B	\$1,432.1 B	5%	\$1,805.5 B
Government Spending on Education	\$941.0 B	\$941.0 B	5%	\$1,184.5 B
K-12	\$687.6 B	\$687.6 B	4%	\$853.1 B
Postsecondary	\$535.2 B	\$535.2 B	5%	\$688.5 B
International Students	\$18.2 B	\$18.2B	6%	\$24.1 B
Executive MBA	\$18.9 B	\$18.9 B	2%	\$20.4 B
Corporate & Govt. Learning	\$133.3 B	\$133.3 B	4%	\$162.2 B
eLearning	\$32.5 B	\$32.5 B	15%	\$65.6 B
K-12 eLearning	\$5.4 B	\$5.4 B	20%	\$13.4 B
Higher Ed eLearning	\$17.4 B	\$17.4 B	18%	\$39.8 B
Corporate eLearning	\$9.6 B	\$9.6 B	5%	\$12.3 B
For-Profit Postsecondary	\$30.8 B	\$30.8 B	10%	\$49.5 B
Child Care	\$65.0 B	\$65.0 B	6%	\$87.0 B
Test Preparation/Tutoring Market/Counseling	\$11.0 B	\$11.0 B	6%	\$14.7 B
Instructional Materials Market (K-12)	\$20.1 B	\$23.9 B	6%	\$26.9 B
Higher Education Instruction Materials	\$4.8 B	\$5.7 B	6%	\$6.3 B

Figure 2. Summary of Education sectors
Source. (Global Silicon Valley Advisors – GSV Advisors, 2012).

The earliest online education initiatives relied on the slow modems of the late 1980s, but they already had many interesting features, involving discussion, assignments and individual profiles. The techniques have barely changed, but, now, things are faster, look better and so forth.

A number of non-traditional Universities have emerged; one of these is North Central University, located in the middle of the Arizona desert. Why build a university in the middle of the desert? Because property prices are low, because the campus itself does not need to physically contain many

actual people, and it probably does not need “extras” such as an athletics track or baseball park. The University is a three story building, in the middle of the desert, which serves a student body of 15,000. There is no campus, but the university is growing and offers masters and Ph.D. programs. The only

infrastructure required is internet access, and this they had. Is there any need for a large lecture hall containing a lone professor talking to the wall? Content is recorded and distributed around the world, so students are no longer required to be in a lecture hall at the same time. Therefore, new forms of online education models such as MOOCs, and other cyber learning programs, will continue to evolve; we will probably see MOOC 2.0, MOOC 3.0 and so on, their content will change and new solutions will emerge.

In terms of technology, the MOOCs are responsible for some of the interesting solutions that are emerging in the education market, such as video capture and processing, content mash-ups, activity analysis algorithms and cloud service replications. However, there still seem to be many missing components, or considerations that those who are offering online programs need to take into account, especially if they are offering them for free. Merely putting something online does not mean that people around the world have access to it. For example, if a server is in the United States, there is no guarantee that people in Africa or India will have easy access to it. If it is difficult for people in the developing world to access Coursera then they are likely to give up. Therefore, service replication is becoming increasingly important.

Social networking activities are going to be central to research into new areas of development and to the engineering of student engagement. Merely displaying or delivering content doesn't ensure that students will learn. A pivotal challenge, in the years to come, will be how to offer the best possible learning options to engage students to the fullest extent. You probably already use Expedia and Kayak to find the best flight deals. In the educational sphere,

companies will emerge to help people find the best content and the most competitively priced courses. There will be more solutions designed to encourage self-empowered edupreneurship: people who have learnt how to learn will be able to take things at their own pace without the need for a professor to provide face to face lectures. In general, self-regulation, self-discovery, and self-learning are more effective than passive engagement. Many people with these high level competencies prefer to learn by themselves, and they will be able to do so thanks to a broad range of solutions that will be available online. In the future, the network will be the educator; the more networked you are, the better you will be able to learn, alongside the other people in your network, which, in turn, will also help you fulfill your academic and career potential. For example, LinkedIn is one of these social networks whose potential should not be taken lightly. Again, the more genuinely networked you are, the more successful you will be.

We have probably all seen the videos produced by providers like the Khan Academy⁹, which are rich in content and subject matter. The Khan Academy started to develop a learning analytics feature that tracks student progress and how much they have achieved or left to complete. But there is so much more that can be done to create a much more versatile and supportive learning environment.

Many other companies are actively providing solutions. Zaption¹⁰ is one of a number of companies that can help clients add a range of assessment features, from questions and activities to video lectures they have uploaded to YouTube. More and more solutions of this kind are coming to the market offering creative ways to ensure student engagement. Interestingly, the founder

of another initiative, The Gooru Learning Company¹¹, was formerly a senior Algorithm Design Engineer at Google. This man knew how to design algorithms for Google, yet he quit the company because he was fascinated by the educational space and wanted to make his own contribution to education. Gooru Learning is basically a search engine for learning; currently it focuses on K-12 (primary and high school) education. Basically, the system works like Google advertisements. When we visit the Google search page, and before we even type anything, ads tailored to our interests appear on the right hand side of the screen. This is possible because Google already knows what we are likely to be looking for and which companies might be interesting to us. Gooru Learning reversed the design so that users did not have to work hard to find the solutions they are interested in paying for. Providers create profiles that display the kinds of learning activities, objectives and content that are relevant to the interests and background of prospective students.

NovoED¹², another MOOC platform which originated at Stanford University, was founded under the name The Venture Lab. This platform is quite different from the rest. It focuses on team-building, team projects and team evaluation. Individuals interested in taking a course provided through the system have to know how to be team players and to be successful, they must earn respect from other team members: there is no free ride. Even if a student finishes the other assignments in the course, he or she will not be able to complete it if they have not earned enough respect from the other members of the team. This, then, is a very interesting system that is likely to influence future online course design focused on global team-based activities.

9 <https://www.khanacademy.org/>

10 <https://www.zaption.com/>

11 <http://www.goorulearning.org/>

12 <https://novloed.com/>



Paul Kim. Source: Particular Archive, Universidad de los Andes

Now, the reason that performance, team and project based-learning are very important is that they are associated with retention. Retention is the most important element of the online education space today. Drop-out rates for on-line courses are much higher than for traditional face-to-face learning environments. NovoED, though small today, is one company that is seeking to design activities and features to ensure students continue their studies. The retention business in online education sector is bound to grow.

Grand Canyon University, located in Phoenix Arizona, is a rising star for several reasons. It was founded 60 years ago as a Christian College but, by 2000, it had lost so many students that it was no longer feasible to operate the University. However, the board made the single most important decision in its history when it opted to revive it. The original due-diligence team went to the University, met with the faculty and visited the campus, which had a traditional look and feel. There was a swimming pool, basketball courts,

baseball fields and extensive athletic facilities. The team recommended the university to a group of investors saying that it had great potential and suggested that investors could expect a return on investment within four years. Initially, they were not convinced. Even though it only had several hundred students remaining and few distinctive or unique features or programs to ensure its survival, it was accredited, which was the most important thing. In the end, the investors reluctantly invested in the university and made it profitable. A substantial on-line program was started in early 2000. In November 2008, it held its Initial Public Offering on the NASDAQ (National Association of Securities Dealers Automated Quotations), raising US\$126 million in one afternoon. The university now has over 60,000 students and is worth US\$2 billion. Retention is key. A one percent increase in retention rates, translates into US\$1.2 million in revenue. This is the kind of online university that is very interested in learning about how to retain more students.

THE SELF-EMPOWERED EDUPRENEUR MOVEMENT

Earlier we mentioned the self-empowered edupreneurship movement. Michelle Phan was good with cosmetics so she started to post videos online about improving make up techniques. Soon she had 1,000 people around the world following her and learning from her videos. These people started to ask her questions and her followers grew to 1.5 million, all because she had posted a few videos on make up. Cosmetics companies started to take interest in her work and her videos and began investing in her, after which set up her own cosmetic company, called *em Michelle*, of which she is the CEO. Michelle Phan's is an example of edupreneurship. In this business model, *edupreneurs* start with their own content and some knowledge or skills to share with the world; if they are good at it, people around the world recognize their talent and companies and investors express interest in helping scale up their activities.

Companies like Udemy¹³ provide a platform for any professor, instructor or teacher who is interested in sharing their content with the world. It provides a platform where *edupreneurs* can post their courses and set their price levels. You can offer your course for free if you want, but if you want to charge money, Udemy is the kind of company that provides the platform for you to do so. This is a very young company, but it already has 1.5 million students and 6,000 instructors who between them have published 10,000 courses. Universities are now aware of Udemy and are offering courses on the platform. This model involves universities honoring credits awarded by Udemy, so if—for example—a student tries an introductory engineering course on Udemy and likes it, he or she can continue their studies by enrolling in the associated university. This is the kind of deal

13 <https://www.udemy.com/>

that some universities are making with companies such as Udemy - a new concept, which is becoming a new trend.

EDUCATION MARKETPLACES

The Marketplace Education Center is one of a growing number of companies that provide free online courses. The business model involves attracting as many people as possible to the programs and then figuring out how to make money further down the line.

Education Portal¹⁴ is another company in this sector, which offers many free courses. DreamDegree¹⁵ is another, and operates almost like Expedia or Kayak. Users can input their interests and budget and the platform finds the course that suits their needs at a price they can afford. Universities compete. Students win: that is the model within this very competitive sector.

Glubal¹⁶, the Global University Network, is a German company, which—as its name suggests—has global reach. Users can search for the programs that best respond to their needs and they can design personalized programs with an individual in mind. For example, a student can take the introductory course while living in Bogota, Colombia and then move on to do the next course in Madrid Spain before finishing the degree in Paris, France. Individuals can design their own degrees any way they want. So this is a new company model which is very innovative and decidedly disruptive too. The fate of these interesting companies will be very interesting to watch in upcoming months and years.

PASSION TO FUEL INNOVATION IN EDUCATION

We have been studying online education since the 1990s, particularly retention and drop-out rates and all the issues surrounding them. Through this, we have found something that is very

important in the educational space, something that is going to get students to complete, something that helps students to continue to engage in class activities. It is passion that gets students to stay in class and finish their studies, and this is something that has to be looked at very carefully. Last year, we offered a MOOC at Stanford called “Designing a New Learning Environment” (Kim, October 21, 2012). Interestingly, we found that many students around the world translated the video contents of the course. It has now been translated into many languages—including Chinese, Arabic, Spanish, and Hindi—by students who took the course and who volunteered to translate the videos. Why would they do this? Why would someone volunteer to translate someone else’s course content and offer it back in the online space? Some students, in particular a student in Germany, downloaded every single video on the course and created low-bandwidth versions. Because many of the videos are quite high definition, a high bandwidth connection was needed. But this particular student, in Germany, realized that many more students needed a low bandwidth version that could

be downloaded in Africa, India and other places.

On the other hand, our research into mobile learning spaces, started with a case study in Baja California, Mexico. The following topics were discussed in our MOOC: Setting the stage. In Camalu, Baja California, indigenous migrant children work in farms alongside their parents. They pick tomatoes every day, there is no school, and they will never own a book to read in their lives. When we visited the area, we were outraged. We felt that we had to help in some way, so that they wouldn’t spend the rest of their 43-year life expectancy picking tomatoes. We began to think about mobile learning and about how to ensure their access to education. We tried out a few ideas, uploading Spanish songs and storybooks onto small devices and experimenting with learning strategies. We later expanded this mobile learning research to other countries, in a process we have talked about in our MOOC. The project was taken to more than 20 countries around the world including Jordan, Kenya, and Tanzania, and it raised the question of what to do about places that have no electricity or Internet (Figure 4).



Figure 4. Mobile Learning Initiatives for migrant indigenous children who have never owned a book
Source. Author

14 <http://education-portal.com/>

15 <http://www.dreamdegree.org/>

16 <https://www.glubal.com/en>

We started to design a small server—with the help of a substantial number of people in Silicon Valley—known as SMILE (Stanford Mobile Inquiry-based Learning Environment). SMILE is a cloud-based minicomputer, in the shape of a small battery powered box that contains an entire learning management system. We know how much teachers hate technology, so we designed it to have only one button. A frowning face appears when the button is first clicked on to indicate that the box is getting ready and is thinking. When the face finally smiles it means that it is ready (Figure 5).



Figure 5. Adhoc local area mobile learning network – content & application server+router+wifi+storage One button and runs on a battery.
Source: Author.

The box contains the whole of Wikipedia, free courses, the Kahn Academy videos, etc. In fact, the device can be used to access any materials or courses the user wishes to access. We are interested in making the device available anywhere where electricity or Internet is not available. Given that a small battery can be easily carried around, the box could be used to access university, elementary school or high school sites and to access pre-loaded content. SMILE also comes pre-installed with PHP Python language so users can learn programming. So, it is a kind of university and school in a box that we are introducing around the world to provide access to education.

SMILE has been taken to places such as Tanzania where students want to learn English but do not have any English text books. We took the device, together

with a number of other mobile devices there, and students have used them to create their own learning content. There are a lot of content providers. If we create content in the US, is it immediately useable in rural areas abroad? The answer is no, because content has to be contextualized, localized, and that is something that a lot of people forget. We are not content distributors; instead, we like to work with local communities to develop local content that makes the most sense for them. For example, with mobile phones, seventy Tanzanian village school students were able to create their own learning content in 20 min-

to such tasks, as they have to read more carefully and pay more attention to the videos. Thus, our idea of the future of learning is precisely to make students come up with their own inquiries, which, in turn, is the best way to engage them to learn.

The Dean of our Business School said: “The millennium students, those who are earning higher education degrees in the 21st Century, are walking through our doors not just to make money but to make a difference in the world”. This is why they are coming to the University and it is what we mean when we talk about igniting passion, it is not about designing some fancy technology to dazzle your students. A novelty act does not keep people engaged for long; we have to figure out how to engage students better. This is what is known as engagement engineering and it is going to be a most important topic in engineering in the future: How you engage people more in desired activities such as learning.

In traditional engineering courses at the US Air Force Academy—teaching Calculus 101, 201, 302, etc.—usually involved professors physically coming in and teaching students calculations that they would seldom remember; a rather inappropriate method. Professor Thomas Reeves—now retired—is Professor Emeritus at the University of Georgia, and has carried out much research in design-based education. Professor Reeves shares my views on the importance of igniting passion among students and when he became aware of how the Airforce Academy courses were run, he decided that passions had to be ignited in their classrooms. The course he designed for them set a practical problem: let’s go to the moon. How do we get to the moon? How might we design an aircraft that could travel to the moon?

This is how the course started and got many students very excited about their new task of starting with a real problem in which they had to consider issues such as aerodynamics, power, lift, weight and all kinds of other dynamics. The university liked and implemented

utes, basically, by taking pictures of objects around them and asking what the objects were called in English!

We have also taken the box to Zimbabwe Medical University which is using it to provide students with access to medical education videos and to carry out their own inquiries based upon them. Students create their own content including questions and feedback from their classes that they then share with us at Stanford University. So both at the Medical University in Zimbabwe and at Stanford University we are able to look at the questions that students come up with and use these questions as our data. The quality of the questions, tell us whether the students are learning or not. They are asked to devise high quality multiple choice questions and provide good answers. This is not an easy task, and students are not used

the course; the professors were able to ignite their students' passions, which, in turn, led to exponential growth in student interest and motivation, as well increased success in achieving learning outcomes. It takes a little longer to design courses using this type of method. But it does pay off. The return on investment is much greater than we might imagine. Such approaches can be applied to any subject, to any class, in

order to innovate and change the world. Let's ignite passion.

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