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Column Better than blackboard

What are we selling?

I love my profession. Even now, after many years, I still tend to think of university in somewhat exalted idealistic terms as in ` I am the first to meet the new generation of mathematicians' or `Universities are responsible for producing and disseminating knowledge.' But in the last couple of years, I've got another angle, mostly due to the interviews and the TED Talk by Scott Galloway. Galloway is a professor at the New York University Stern School of Business and a successful entrepreneur. He looks at higher education as a business, and he is very outspoken about its flaws. He even says: `we fail the current young generation'. While Galloway's laments are heavily USA-based, it is refreshing to look at my idealized mission – educating young generation – as a business.

Welcome to the new issue of `Better than Blackboard'! Today I will try to discuss a simple question. If a university is a business, then what exactly are we selling? For this article, our student illustrator Mara Chelărescu made a very creative comic strip! I hope you will enjoy it as much as I did. Check out more of Mara's art at https://cara.app/vinyllaroll.

The four products

In his interview on October 26, 2020, Scott Galloway predicted disruption of the USA higher education based on a simple price/innovation analysis. Look at other sectors, say, in 1980 and now. Telecommunications have improved beyond recognition and are even cheaper than before. Healthcare has become more expensive but what modern medicine can do borders with science fiction. And now look at higher education. The college tuition in the USA has increased about 14 times, and yet, we sell the same product: a professor standing in front of the blackboard. At that time, Galloway said that blown up price plus the lack of innovation is a clear sign of a sector on the verge of disruption.

This sounds logical, if we agree that our product is the traditional lecture. However, the total picture is more complicated. Of course, being a business professor, Galloway realizes that we are not selling lectures per se. In one of subsequent interviews, he talked about three products that the universities sell: certification, education and experience.

While I agree with this in general, I find the `education' product not specific enough. As a self-learned education expert, I will allow myself to split education into two separate products: the curriculum and the learning process.

So here is my list of products offered by the university to the young generation:

- Certification/degree
- Curriculum/study program
- Experience
- Learning process

You may disagree with this classification, and please feel free to define our product in your own way. But I believe this list is reasonable, so I will stick to it in this column.

The steep costs

Whatever we are selling, our product is not cheap. Even though tuition in the Netherlands is much lower than in the USA, still, the tuition, the rent, and the living expenses, add up to large amounts. But the money is not the only and maybe not even the most important cost. Students also invest their precious time, the best years of their life, full of energy, passion, and creativity.

Besides the time directly spent on studying, there is also an enormous opportunity cost because the choice to study at the university also means the choice not to do many other things. The students could work, gain experience, and earn money instead of spending it. They could learn all the material online by themselves from the best professors in the world. They could also learn many other things, like coding, several languages, or making art with AI. They could start their own business, work for a political party, make career in sport, launch a YouTube channel, or write a hit song.

Just think about a two-hour lecture for 300 students. It is 600 priceless hours of talented young people. 600 hours that they will never get back. Whatever we offer for this price, it better be good.

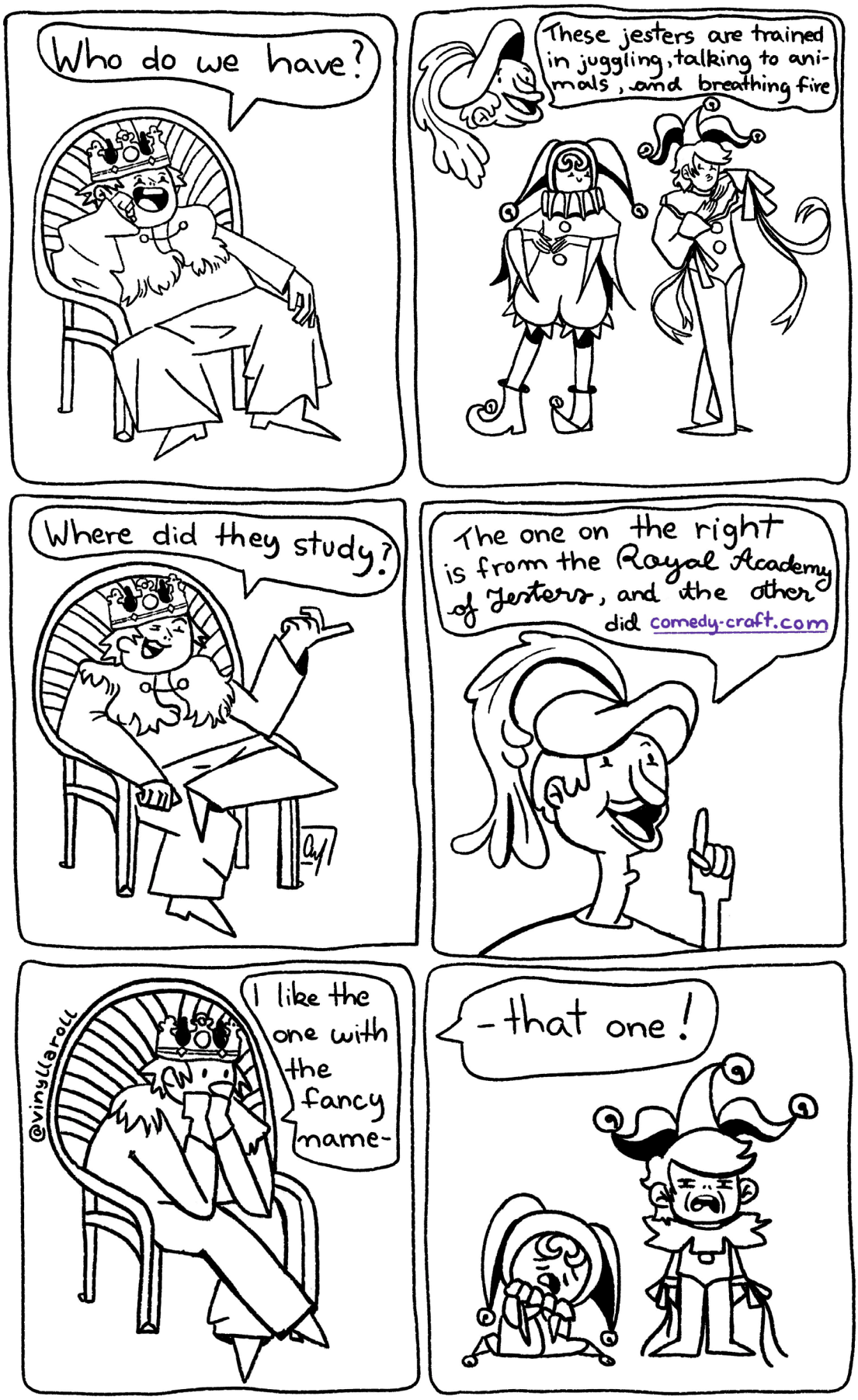

Illustration: Mara Cheláriescu

Skill is all that matters?

Given the costs, we cannot get away with common vague formulations like `implicit non-tangible benefits of being in the class', even if such benefits exist. This is why I prefer to identify our products in specific terms, as I wrote above: certification, curriculum, experience, and learning process. In the following sections I will go though these products one by one.

Certification

When I talk to colleagues about innovative education, one response that I often hear is this: `But why do you worry so much? Aren't the companies happy with our graduates?'

Yes, the companies do look at our degrees and they do like to hire our graduates. If we are to judge a product by its market value, then the certification, or degree, is our very successful product.

In the modern polarized society constantly shaken by disruptive innovations, it would not be possible to maintain the high market value for our degrees if they were not a solid product. And they are. Our exam system is very rigorous. At the TU/e, the course support is primarily about supporting the exams. New examination schemes must be approved by the Examination Committee. We must keep exams for two years for the record. Master theses must be read by external members not involved in supervision. All these rules and regulations are in place to ensure the validity of the degree. As teachers, we spend lots of time setting up the exams, grading, and complying with all the rules. In the end, our degrees do guarantee a certain level of knowledge, because it is not possible to get a degree without any knowledge.

I acutely realized that certification is central in our system at the beginning of the COVID pandemic. The entire education had to move online in one week, but by far most worries and most effort were around one thing: exams of Quarter 3 in April. At that time, I found this very sad: we are in a global pandemic, and our main issue is how to police the students? But if you think that the degree is our most important successful product, this totally makes sense!

Unfortunately, there is a dark side to this as well. We get a glimpse into it every time when a student asks, `Will this be on the test?' Students' preoccupation with grades is disheartening, but also understandable. University study goes at a very high pace. If a student tries to learn deeply and starts legging behind, they will not collect the necessary credits, with significant personal and financial consequences. We want students to learn, but the entire system places both teachers and students in a grade race that probably nobody likes. The knowledge suffers, too. We all see this, for example, when in our course we need to rely on the knowledge from previous courses.

And what about the companies? Next time you talk to them, ask them: why exactly do they like to hire our graduates? Ask them: what if someone learned the entire program on Massive Open Online Courses (MOOC) platforms such as Coursera? I did ask this question to a senior person from a big tech company. Their answer was nothing I hoped for: `*You know, we have many applications. I don't care what these people did on Coursera, I don't know how to judge this. I prefer to hire someone from a good university because these professors know what they give the grades for.*'

While it was good to know that Coursera would not wipe us out, notice that this person did not say `*because these applicants learn from the best professors*.' They see our grades as filter, that's all. That universities serve as filters, is not just my personal thought based on one random encounter. This is one of the main storylines in the book *The tyranny of merit* by Harvard's Michael Sandel [1]. The book opens with a recollection of a college admission scandal and returns multiple times to the idea that colleges have become the filtering machines, the gatekeepers of social mobility. Other thinkers echo this as well. Scott Gallaway says that recruiters should stop 'fetishising' elite universities[14]. And Malcolm Gladwell in his book `I hate the Ivy League' proposes to prohibit lawyers to ever ask or tell, from which university they graduated!

We take certification seriously, and this is good. But are we happy with the students showing up only for the test? Companies value our degrees, and this is good. But are we happy to be a filtering machine?

Curriculum

When MOOC rage started at the beginning of 2010s, many people said the universities were doomed. Now everyone will study online for free. This prediction was wrong. The number of students has increased greatly since then. And as we discussed above, this is not surprising. MOOCs don't have the same trust in their degree (or, if you wish, the same filtering power) as universities do. So, once it became clear that we survived the MOOCs, I started thinking: `okay, online education didn't kill us, but online certification will'. It's only a matter of time that companies start running their own online tests for job applicants, and then the universities will be in big trouble. This thought was partially (albeit anecdotally) confirmed when my own daughter was applying for a company job. The recruiters required the degree but weren't interested in the grades very much; instead, she took an online test designed by the company.

However, soon I realized that this, too, is not so simple because of our other product: the curriculum. Suppose the companies want to run their own certification. Great, but what will they certify for?

At the university, we test the knowledge and skills according to the study program that we offer, and its envisioned learning outcomes. In all honesty, I believe this is our absolutely brilliant product!

Universities are uniquely positioned to create and update the curriculum. We have a large network of international experts, companies, government and alumni. We know what happens on the forefront of research, we know what industry and society need now, and we can anticipate what they may need tomorrow. We also have the time and the huge motivation to enthusiastically bring all this knowledge into our programs.

New study programs constantly appear. In front of my eyes, University of Twente opened several unique programs, including Technical Medicine and Creative Technology. But even traditional programs, such as Applied Mathematics, are regularly revised and updated.

Curriculum is an important motivator. If you ask students how they choose the university, and why they want to study there, they most probably will talk about the program.

The companies will not replace us in the role of creating and updating study programs. Yes, maybe big tech can train and certify their own software engineers. But their own computer scientists? I seriously don't think so. And from what I hear, they are not interested either.

This is why any work in curriculum committees is very valuable. But even outside

such committees, we all work on the curriculum one way or another at all levels: from setting up new programs to designing and revising the end terms, compiling the courses, and choosing the content of each course.

Besides the exam, the teachers spend lots of time on what material exactly we are going to teach. And I must say when I hear my colleagues talking about this, I feel nothing short of admiration. We want to offer our students a high-quality contemporary content, and I believe we do.

Experience

On-campus experience is most likely the main reason why the students are so eager to join university in the first place. It was definitely so for some students I personally know. Students come here to be among like-minded young people, to party together, to get through troubles together, to fall in love, to make friends for life, to lay a foundation of a professional network for the entire future career. This is more than just socializing. This is our students' life.

Experience is also the campus, the facilities, the labs, and the opportunity to work with experts in the field.

Whether we like it or not, the social, interactive, and experiential aspect of being on campus is much more important than sitting in a lecture. Research consistently says that theoretical courses can be successfully given online. For instance, the meta-review [5] (with over 1600 citations on Google Scholar) says, `*Taken as a whole, there is robust evidence to suggest online learning is generally at least as effective as the traditional format.*' And that was in 2015!

Yet, we insist on being an on-campus university, and we are right about it. Even if one can learn effectively online, the experience can be gained only live, face-to-face, in a physical space. Maybe this is the `intangible benefit of being in the class' that my colleagues often refer to.

There is a big difference between online and face-to-face connections. I like how Haidt explained it in his book *The anxious generation* [4]. He says that online relationships may start in one click, but a tiny misunderstanding may end them in one click, too; one person blocks the other, end of story. But face-to-face relationships are more resilient and forgiving for mistakes. Misunderstandings are discussed and resolved making ties only stronger. The students need this space to make blunders, both academically and socially: this is how they build resilient social and professional networks.

A striking example in that sense is the innovative college Minerva [5]. Minerva had the opportunity to build a new college from scratch, with current knowledge but without any legacy. They ended up giving *all* their courses online! But they did not overlook the crucial value of experience. In fact, they have created a unique experience for their students: the so-called Global Rotation. During their studies, Minerva's students live in seven different cities all over the world, and the entire batch moves from one city to another. (The cities listed in book [5] are San Francisco, Seoul, Hyderabad, Berlin, Buenos Aires, London and Taipei). They become close due to being together and exploring the city together. The program carefully plans that the students immerse themselves into the city and get a deep understanding of its culture. This ends with a group project in the spirit of challenge-based learning: students solve a societal problem in that city, usually in collaboration with a civic partner.

I believe that students in the Netherlands are lucky, because the Dutch universities offer everything for excellent experience. However, there are also worrisome developments, which I have already mentioned in my previous column [3], that damage the experience greatly and will damage it further if we don't do anything about it.

I observe already for some years that we have been losing the sense of community between teachers and students. With large classes, I don't know who my students are, and they don't care who I am. During COVID lockdowns, different questionnaires showed that the students missed contact with each other badly, but didn't miss contact with the teachers.

There are of course exceptions. I know one example of a study program that explicitly cultivates community. I won't name it because I didn't work with this program first-hand. But I heard that at the beginning of each quarter, they have a meeting where students meet the teachers, and the teachers can talk to the students, and tell them about themselves and their research. This program often receives the top-program status from the *Keuzegids* (Choice Guide, based on the students' questionaries). I believe that the community plays a large role in the positive experience that students consistently report.

Even more alarming, after COVID, I feel that the social cohesion between students themselves is reducing as well. And this is very damaging, because education, especially on-campus education, is not a logical, but a social and emotional process.

And that brings us directly to our one last product.

Learning process

If you have read my previous comments, you know they are all about this: the learning process. And you also know what I think about it. The traditional way of teaching mathematics, with lectures, tutorials and exams, simply does not work.

This is the one product that didn't get much update from 1980 or even earlier. Many of my colleagues don't see this as a problem, some are even proud of it. But I believe the update is necessary. For me, the most obvious reason is that this traditional learning process is completely orthogonal to the current scientific knowledge about how young people are motivated and how the human brain learns. I have discussed the latter at length in my previous column [6], and I mentioned the former in [3], with references to the literature, such as books [7] and [8].

For learning, the students need *engagement* (to be actively working rather than passively listening); they need *inconsequential error feedback* (the space to make mistakes and get feedback to improve), and they need *spacing* (learning regularly in small portions) [6,7].

For motivation, the students need to feel that their presence in the class is meaningful, that it makes a difference for someone, and they need to feel respected for doing this work [8].

Even if some mathematicians sound like they don't believe in neuroscience or social psychology, I think we have ample own data to draw the conclusion that the traditional lecture-tutorial-exam approach is close to dysfunctional, especially in math courses for non-math students. Students vote with their feet. At the lectures, we are

happy if half of the students show up, and tutorials bleed empty already at the start of the quarter. This does not depend on the teacher, it happens everywhere.

How can we improve the learning process? In terms of learning, there are many ways to improve, even for large groups. I discussed many of them in my previous columns. For example, we can improve engagement by replacing the lecture with more active forms such as quizzes, guided exercises or asking students to come up with questions, as discussed in [9]. We can introduce spacing and inconsequential error feedback by asking students to do exercises and then discuss them in groups without grade (as in [10]) or by using alternative grading (as in [11,12]).

Recently Brandon Kelly, the Director of Introductory Math at Harvard, visited 4TU.AMI and told us about their approach. They create groups of 20 students, and each group has an instructor. During the classes, they use Liljedahl's `Thinking classroom' approach [13]. The instructor only briefly introduces the topic, and then the students work on the problems at whiteboards in random groups of three. Bart van den Dries and Jeroen Spandaw from TUDelft also use *Thinking Classroom* to teach proof techniques to first-year mathematics students.

Unfortunately, it is hard to scale up *Thinking Classroom* to groups larger than 20 students per instructor. At Harvard they involve many instructors: PhD candidates, postdocs, teaching and research staff, and there is a director who runs not only the courses, but also comprehensive training of junior instructors. This sounds like too many man-hours for a Dutch university. Yet, maybe it is more useful to build smaller classrooms with whiteboards on the walls instead of large lecture halls.

Improving motivation is more difficult, but I believe that making the students feel seen is the right place to start. Some of my colleagues make effort to know their students, and these are, time and again, most favorite teachers. Brendan Kelly shared a simple and specific approach that they use at Harvard: they ask each student to make a PowerPoint slide about themselves, and the instructor must go through the deck of slides before the classes start. I think, even if the group is very large, I would like to go through such slides, to know who my students are. I believe that this will help to create at least some sense of community and purpose, and that the students will have more reasons to believe that they are seen and their contribution matters.

What is your favorite product?

When I talk to my colleagues about education, they sometimes interpret my words as `our education is not good'. But this is not at all what I am saying. Our education is fantastic in many ways. In terms of this column, we offer a package of four products: certification, curriculum, experience and learning process. I believe that a large part of it is excellent. We offer valuable degrees, exciting modern programs, and great experience on campus with many talented young people, social events, cut-edge facilities and enthusiastic world-class experts.

But I do believe that in terms of certifications, we can and should relax the grip of grades and grading. In terms of experience, we can and should strengthen the community between teachers and students. And we must improve our outdated learning process! Not only for the sake of the students, but for our own sake as well. Because a better learning process will make teaching so much more rewarding!

Maybe Scott Gallaway was wrong in predicting the near disruption of higher education. But our learning process badly needs if not disruption, then a rapid gradual change. I will keep working on it because this is my favorite product, and I want it to shine.

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