# *education for creativity, skills, and cross-disciplinary collaboration*

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*Abstract* - A recent realization is that the current education does not adequately prepare students for the jobs of the future. Rather than narrow specialization, what will be needed are skills and attitudes that vouch for a smooth transition from school to work place and the ability of a young person to further develop but also adapt to the demands of the job. Many universities are now looking to develop basic skill sets which emphasize such things as communication, team work, creativity, and cross-disciplinary competence. This is specially the case for technically oriented schools, whose students will enter a world which favors collaboration-driven innovation, currently regarded as the best way to rapid development. While the current university curriculum still invites relatively passive learning, new initiatives have been taken for such things as creativity workshops, or faculty development seminars for re-imagining education. One recent experiment at my own university was an Artificial Intelligence Collaboration Day with "flash presentations" by students and faculty as well as longer presentations and group discussions. The idea was for people from widely different fields to identify common interests for potential collaboration, and this worked well because of the friendly atmosphere. The most tangible current experiments are specially built "innovation centers", such as the new Kaplan Institute for Innovation at Illinois Tech - a building which is specially designed for innovation through collaboration. Flexible architecture and new interior design can quickly adapt to the needs of different projects and audiences. The biggest challenge, however, and a key concern for the education of the future, is creating a learning climate where quiet individual students can develop into happily communicating, competent and confident human beings. I will mention some of my own experiments in this respect within the American university system and finally take a look at a surprising but functioning alternative: the Finnish educational system and its underlying values.

***Keywords—education for creativity, skills, innovation, cross-disciplinary competence, collaboration, equality, Finnish education, learning to learn.***

## *THE FOURTH INDUSTRIAL REVOLUTION AND THE PREDICTED SKILLS GAP*

It is becoming increasingly clear that the time when a student could enter higher education with the aim to pursue a lifelong professional career is over. Comparing the preparation required of the future work force to what is now offered by our schools, a number of high level reports following the alarm sounded by The Fourth Industrial Revolution [1] agree that the current system of education does not adequately train our college graduates. There is even the observation that the speed of technological development makes knowledge from a student's first year of college obsolete at graduation (e.g., [2], [3], [4].

One problem, then, is the sheer speed of technological development, and particularly the expected "outsourcing" of many jobs to artificial intelligence, robotics and the like, which will be drastically changing the work place environment. Meanwhile there is the need for a "pre-prepared" work force since there won't be time any longer for traditional on the job learning. But the most important aspect is the nature of this required preparation. The current emphasis is on skills and capabilities rather than the mastery of special types of knowledge, and these skills would have to be acquired well before the transition from school to work. In fact, the very transition itself would need to be smooth, which means the additional possession of a set of suitable attitudes or character traits, such as flexibility and adaptability as well as a capacity for continuing learning and development.

So this is now what the educational system is expected to deliver, and fast! The Fourth Industrial Revolution manifesto-like tone at least initially created an impression of an impending disruption of existing institutions because of the switch to widespread employment of AI in the work place. This is an unusual and rather awkward situation for most universities and their faculty. Nevertheless, many universities are valiantly looking for ways to respond to the challenge of preparing their students for their future jobs, finding ways to develop "21st century skills", that is, broad general skills rather than specialized technical competence. The challenge is especially felt by technically oriented schools, whose students will be entering a potentially unfamiliar work world of collaboration-driven innovation. As shown by surveys of company CEOs across a number of central industrial fields, the desired skills are of a clearly cognitive and social type: communication and problem solving skills, and ability to think creatively and critically. Later there has been mention also of such things as empathy and ethics – far from the "hard" skills traditionally expected of engineers...

Interestingly, and perhaps ironically, what employers wanted more of in regard to "communication" was nothing fancy at all but good old-fashioned face to face communication in order to increase internal work place efficiency. Quick interpersonal exchange typically beats emailing, which may actually slow down internal workplace communication and fail to quickly clear up misunderstandings. Meanwhile, emailing had often become the chosen method of communication.

In 2019 the World Economic Forum issues an updated Future of Jobs Report in regard to required skills in 2022. The report looked at the trends expected in 20 economies and 12 sectors of industry. It predicted that workers will see a shift of 42% in required workplace skills in the period leading up to 2022. Important new skills were among others proficiency in new technologies and the ability to become a life-long learner. The report upheld the importance of "soft' or "human" skills: "'Human' skills such as creativity, originality and initiative; critical thinking, persuasion and negotiation will likewise retain or increase their value, as will attention to detail, resilience, flexibility and complex problem-solving. Emotional intelligence, leadership and social influence as well as service orientation are also set to see particular increase in demand relative to their current prominence today" [4].

## *A CULTURE OF COLLABORATION?*

If radical disruptions will indeed be happening already by 2022 time is very short for "retooling" the workings especially of such complex institutions as universities. Not only will there be disruption as many tasks of the staff will be taken over by artificial intelligence, but we have here potential challenges to the traditional university structure itself, and its explicit and implicit connections to the education and job prospects of its students. It has therefore been seen as important to start preparing workplaces, including universities, for the impending changes caused by the upcoming shift in skills demand.

But even ideas of reskilling or upskilling [5] are only foreshadowing bigger changes which involve both the structure and culture of organizations, we learn from this document. Structure-wise, it is argued, organizations will have to become less hierarchical to their nature and have a more "flat", network oriented shape The reason for this is the larger underlying need for relying on multi-disciplinary teams for everyday working tasks and for problem solving. Organizations also need to undergo a cultural transformation, moving toward a greater openness to collaboration with a special eye toward innovation.

Although these kinds of suggestions typically refer to conditions in companies, they are applicable to change at the university level as well. Both faculty and staff will need to be made aware of impending changes as well as the concrete measures that can be taken by individuals for improving their chances for a successful transition to a new or reconfigured job. There are several examples of synergy between business, government and educational institutions. In some cases, local collaboration between companies, governmental and educational institutions has given rise to successful joint training programs for their employees. In this way whole small communities have been sustained.

In anticipation of the future, at my own university, Illinois Institute of Technology, new initiatives have been taken for such things as creativity workshops for students, or faculty collaborative development seminars for re-imagining future education. One recent experiment at our university was an Artificial Intelligence Collaboration Day with "flash presentations" by students and faculty, as well as longer presentations and panel discussions. The idea was for people from widely different fields to identify cross-disciplinary common interests for potential collaboration. This worked well because of the skillful handling of the various issues and the friendly atmosphere generated by the organizers. There are now internal AI collaboration networks in place that unite faculty across various subject matters, for instance one on AI and ethics. Members of these networks meet in person as well as online. More recently, the faculty and staff have been invited to join task forces within the framework of a strategic planning initiative, discussing such things as future scenarios, student success, and a new core curriculum.

## *DEVELOPING CAPABILITY WITHIN THE EXISTING SYSTEM*

It will obviously take some time to "deliver" the desired skills increasingly required by employers. The projected "skills revolution" will obviously have to affect the curriculum, too. At the same time, nothing is yet settled and many alternatives are on the table. For instance, it doesn't seem obvious that a university aspiring to be a tech leader should try to mimic the organization of, say, a tech start-up company, however intuitively conducive to innovation that type of structure might appear. Instead one should look to networks of collaboration between companies, educational, and governmental institutions, and such things as common training programs, or coordinated actions of various types. But this will happen "down the road". But in the meantime our students are graduating and will need to be qualified for jobs. How do we meet the skills challenge for them?

I believe we need a two-pronged approach – we need to plan both for the present and the future. There need be no contradiction between such plans.

For "soft" rather than technical skills, an obvious short term task could be to make manifest the skills and competencies already addressed by existing courses (such things as communication, logical argumentation, creativity, critical thinking, cross-cultural understanding, ethical reasoning, etc.) and explicitly state how these relate to the desired set of future skills. Additionally, we could note that other desired skills have in fact been covered implicitly. Many curricula include internships and various types of practical training. Students are also encouraged to explore the opportunities for "experiential learning" and "service learning". (Say, participating in the volunteer work of Habitat for Humanity during Spring Break, or tutoring high school students). Outside the classroom, students gain leadership experience by being active in student organizations and sports. At Illinois Tech we also have a Leadership Academy, which arranges various relevant training sessions, and hands out a leadership certificate for those who have participated in a specified large number of these. Each fall it arranges a fabled "sophomore retreat" for all second year students at a nearby lake in order for them to develop leadership and team building skills in a camp-like environment. So in these and other "extracurricular" ways, some of the desired skills and abilities have in fact already begun to be developed.

However, as we wait for major educational reform and potential envisioned major "disruptions", I believe it is possible to start the needed skill training already within the current educational system, using "student power" with the teacher as catalyst, and starting right now. I believe some of the insights and teaching strategies I have developed over my career as a university professor can come in handy [6], [7] and I will turn to them now.

## *THE TEACHER AS CATALYST*

A university has to have a culture that make all students feel included, and this from the very day they arrive. But it doesn't necessarily happen spontaneously – unlike small kids, older students do not spontaneously play with one another. Meanwhile the early social get-together opportunities arranged for students early on in the semester do not necessarily guarantee everyone's inclusion. Meanwhile, it has been shown that what happens in the first two weeks or so are absolutely crucial for a student's decision to stay or leave the university. So what can be done to better integrate new students, at least make them talk to each other? One answer is: a little social engineering. After all, students have to go to class. And here is where the teacher comes in!

The aim is to break a potential vicious circle: even if many students in the class would wish to talk with each other, they don't, because they don't know each other. But the teacher is not part of this odd understanding. She has the power to make the students talk to each other by simply asking them to form small discussion groups, give them a topic, and then ask for each to give a group report to class. It may surprise the students at first, but they will do it, and that is the beginning of a new life.

This group work activity has multiple benefits attached. Being part of a small discussion group makes it easier for students to get to know classmates and to dare to speak. Fear of speaking in class is surprisingly common, and should be handled in a friendly way. (The larger aim is to build a class where every student will *want* to participate). The whole class can get slowly acquainted through various cross-cutting group activities, also in the form of bigger interest-based research projects and group presentations. Students are interested in what their fellow students think! Both the students and school benefit from a good class climate. Much of student success and retention has been shown to be directly dependent on completely extracurricular factors, and one of the most important ones was simply having a friend in the class. [8]

I believe it is in small groups that most of those much desired skills of communication, problem solving, creativity, etc. are best developed – and this can all happen within the framework of the existing curriculum through the actions and interactions of the students themselves, as the teacher makes group discussions and projects a natural part of the course work. It is not necessary to sacrifice a lot of precious class time (the group discussion could be a matter of just 10 minutes), but the point is to make group work an expected feature, and fun. Group work is also the natural place for developing team-working and leadership skills, and even self-discovery. Many have found their own hidden potential in this way. (Some have found that they are natural leaders, for instance). [7]

Group projects and presentations are great ways for students to become active researchers and collaborators. This happens especially in my class Science and Society. I typically ask students to find an emerging technology that they would like to explore further, both for its technical viability and its potential social and moral implications. I start with having the class getting inspiration from Joel Garreau's exciting book *Radical Evolution* (which ably discusses the social implications of various new technologies) [9], and then they self-organize into independent thematic teams and start preparing material, both for a write-up and a final class presentation of a topic that interests them – while updating the insights in Garreau. This kind of cross-disciplinary exploration really turns the students on, and they are good at finding materials (they first get a small hands-on lecture by a friendly librarian) and genuinely interested in each other's presentations, be they on AI, computer-brain interaction, or the promises and problems of CRISPR. The students also produce marvelous visuals and video clips to illustrate their points. One student told me that he now thought he would go into AI because he learnt from another group's presentation that the field had now developed in a direction he liked.

An advanced option is to develop courses that are expressly devoted to project based learning. One such idea is the existing IPROs (Inter-Professional Projects) at Illinois Tech. This initiative has been going on for some twenty years already. In order to graduate, every student has to have taken two of these IPROs, a "practice" one, explicitly designed to acquaint students with various skills, methods and techniques, and the other, a "real" IPRO, involving identifying and solving problems, and coming up with patentable ideas. The second IPRO often involves sponsorship and involvement from some company, providing a "real world" touch. These projects are then exhibited, presented and assessed by judges on the IPRO Day held every semester. (Currently this system is being reorganized to allow for maximum student choice when it comes to topic and approach for the cross-disciplinary teamwork, allowing them also to consult with professors from different disciplines who will be available for the students at the same time).

### *"IF YOU BUILD IT THEY WILL COME"*

This is a famous quote from the movie "Field of Dreams", which featured an Iowa farmer (played by Kevin Costner) hearing voices telling him to build a state-of-the art baseball field in the middle of his corn field. So he built it, and the Chicago White Sox from long past came to play memorable matches in the night. In a parallel way, one might ask about creativity and innovation: if you create the right environment for something, will it happen? Or more specifically, what if you build a building specifically for this purpose, locate there the Institute of Design, make this the home base for the Inter-Professional Projects and their Idea Shop, and provide working space for various types of university workshops, initiatives and presentations. This is exactly what happened in the case of Illinois Tech's Kaplan Innovation Institute, which was inaugurated in the fall of 2018.

The flexibility of the interior (movable walls) means that different size groups can reserve spaces for various activities. The spaces come equipped with white boards and idea posting boards, projection screens, and the like. The tables are rollable and can be configured in many ways. Here and there are smaller spaces for group discussions, but the most probable place for that is really the newly installed first floor cafeteria. The building is open to all of the Illinois Tech community. It is all transparent, too, since the whole building is made of glass. It is here that many of the university's recent Future of Education workshops have been held, inviting all of the faculty and staff to various collaborative idea-generation exercises regarding the future of this university.

How well does this two story glass building work? This is a question under investigation. Some answers will be coming from my class of (mostly) architecture students whose task it will be to examine whether the Kaplan Institute is in fact successful as a "creativity enhancing" space. These students have already familiarized themselves with other supposedly creativity boosting spaces, some of which exist in Chicago (e.g., "innovation labs"). What role does the spatial design play for the feeling of creativity and the creativity of the actual final product? My students will compare the original intentions of the architect with the actual use of the building, also looking for creative use of unplanned spaces and assessing what works, what doesn't and what could be improved. They will be interviews of the building's resident "workers": the Design students who have personal desks within an open plan on the second floor, the Design faculty who have their open plan offices there, and the IPRO and Idea Shop

students who have their workshop (enabling prototyping) on the first floor. How does it feel to work in a completely transparent building? Does it assist the sense of collaboration? Many questions await answers and will be answered soon.

## *VALUE AND VALUES OF EDUCATION*

There is currently a great concern in the United States about the cost of education, and many wonder if a college degree or higher is worth the price. This may be getting more pronounced as the demand for particular job skills and background capabilities increases with the onset of increased automation in coming years. Also higher university administrators are aware that there may be place for fewer colleges and universities in the future, which means that some will have to close. Everyone naturally would not want this to happen to their own institutions, which is why there is such an incentive to do something about academic education and rethink the content of the core curriculum.

A particularly bad problem is the huge debts that many students have incurred. These turn out to be difficult to pay back, and many young adults end up moving back to their parents. At the same time this postpones their abilities to plan their own future and create their own families. This, in turn, is part of a bigger economic problem, as has been noted by leading economists, and increases the national debt as well as the current trend toward growing income inequality, both in the nation and at the global level. [10]

The director-general of ILO, Guy Ryder, is more optimistic, pointing out that "As tech disrupts our jobs, it's not too late to turn pain into gain" [11] He notes that the digital divide between developed and developing countries is becoming more acute, and this has also to do with workforce capabilities: "skills matter, if we want to use technology to decrease, not increase, inequalities". The increased use of AI will particularly affect areas such as business administration, transport and healthcare. But depending on how the transition is managed, it could also be beneficial, he argues, especially if the workers can quickly learn requisite skills – and this means actually "soft" social and interpersonal skills! A productivity revival in turn would generate more jobs of both an existing and new kind, which would be able to take care of the rising new populations of job searchers. [11]

The Fourth Industrial Revolution likes to use the term 'disruption' – and this might be applied as well to the system of education. Some current American presidential candidates suggest major changes in the whole educational system, demonstrating how a transition to free education for all, and forgiving at least part of existing debt would enormously benefit both individuals and the country as a whole (so far mostly Bernie Sanders and Elizabeth Warren). This is an unusual turn in American politics and we will see how it works out.

At the same time the political discussion about education addresses fundamental national values, such as the right of every citizen to an education and a job, and the basic idea of equality and equity. That is a discussion already held in some countries, maybe most radically in Finland, where all political parties agree about the importance of education and where the whole educational system from kindergarten to university is free, students are provided with free lunch, and the teachers are well educated (with Master's degrees), well paid, and well trained in teaching methods and child psychology. There are no mandated standardized tests, and no ranking or competition between students, schools, or regions. All schools have the same national goal and all children have a chance for the same good education independently of where they live. Meanwhile the teachers are given independence in their teaching, and trusted to do their best – with the result that their professional self-concept and pride is tied in with student success. In such a system the solution of any arising problem presents a personal and collective challenge to be examined with help of colleagues [12], [13], [14].

The change in the Finnish educational system which started in the 1970s seems to have produced good results. "Equality is the most important word in Finnish education. All parties on the right and the left agree on this" according to an interview with the president of Finland's teachers' union [12]. While the right to education and the idea of equality (also in the sense that slower developers may need more time, and that struggling students should be given more help) can be easily grasped as a basic value, what may sound more counterintuitive is the emphasis on short school days, short lectures, long breaks between classes, and little homework. What?! How do these children learn anything? The answer is that they actually do, and one proof is their excellent result in science, mathematics and reading in the global PISA assessments when they were first administered in 2000. (Later the scores have dropped a bit but they are still very good). Another could be the statement of the author of *Finnish Lessons 2.0*: "We prepare children to learn how to learn" [13]. There is in fact supportive scientific evidence for at least a partial explanation of why this system works – the most drastic coming from a medical doctor, who demonstrates that the most important predictor of student success is not at all connected to any academic factors but has rather has to do with extra-academic ones, such as emotional security, sufficient nourishment, sleep, exercise, etc. [8] And teachers follow psychological insights that seem to be the right ones: every child is different and learns differently. (For the need for a person-centered education, see [15]).

So, in a sense, those skills and attitudes that are now so much sought after by employers have already been prepared in schools that have created a good educational climate and encouraged the personal development and interests of its students.

There has been talk about "importing" the Finnish model to other countries. It is "expensive" in that it is based on close attention to the development of each individual student, and positive intervention when needed. "Whatever it takes" is said to be the attitude of the teachers. One argument is the Finland is ethnically so homogenous. But the system has proved successful also in entry-level schools with some 50% immigrants who may also have to struggle with the difficult Finnish language [12]. Another objection, that Finland is a small country, is met by education guru Ken Robinson by him comparing Finland to the United States, where education is typically organized at the state level. Robinson in fact recommends the Finnish system for other countries. In his book *Creative Schools* he formulates it this way: "Finnish schools do not do these things in addition to achieving high standards – they achieve high standards precisely because they do these things" [16], pp. 60-61.

I have been bringing in the Finnish example as an alternative educational system based on at least seemingly different values and priorities, and where the country has simply decided that the best use of its national resources is to educate its citizenry. "This makes economic sense in many ways, since students who drop out (for whatever reason) typically do not catch up later, while an investment in education can be expected to keep young people away from the street and out of prison… The educational system is central to the core values of a nation and might or might not be seen as conflicting with economic interests (depending on what is included in "economic interests" in the first place). This is also why the World Academy of Art and Science (WAAS) over the last few years has been developing both a new economic and a new educational paradigm [17], [16], and pursuing a (non-disruptive!) transformation of education at a global scale through the recently founded World University Consortium and three international conferences on The Future of Education.

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