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Blending Hard and Soft Skills with STEAM
—From Concept to Case Study—

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Abstract

Categorization of skills learned in formal education can be polarized into hard skills and soft skills, with associated advocates of either one or the other. Scientists, educators and governments may hold different views about the skills which are necessary for the workers of tomorrow to learn today. There have been calls for the hard skills connected with STEM (Science, Technology, Engineering, and Math) to be balanced with the soft skills of liberal arts, resulting in a more suitable education. This paper finds that the endeavor to find such a balance is not an appropriate tack as, in order to attempt a balancing of the skill sets, the discourse would move to a debate surrounding what the correct proportions of each should be. An alternative way of blending the STEM skill set with those of liberal arts resulting in an integrated educational paradigm called STEAM (Science, Technology, Engineering, Art, and Math) is discussed, with a practical case study of a European STEAM summer camp presented. It is found that, in the case of K-12 students, this cohesive STEAM concept is proving successful, raising questions about how subsequent secondary and tertiary education may be affected in the future.

Keywords

STEAM, summer camp case study, blended learning

STEAMでのハード・ソフトスキルのブレンド型学習
—概念からケーススタディへ—

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1. Introduction

Students, regardless of their academic discipline, need to study the art of speaking articulately and gain the ability to communicate their thoughts clearly (Linguistics, 2015). Furthermore, they benefit from programs that motivate them to “work hard, study efficiently, and ask great questions about the future” (Strange, G., as cited in Linguistics, 2015, p. 3), especially when the experiences offered by those programs “extend learning beyond the four walls of the traditional classroom”, giving them “real world experiences that will enhance the learning back in the classroom.”

In recent years, there has been a categorization of education into “hard” skills, such as those taught in STEM (Science, Technology, Engineering, and Math), and “soft” skills, such as those learned in liberal arts programs. The hard skills are said to include more tangible, easily verifiable and knowledge-based abilities, and include “specific, teachable abilities that can be defined and measured, such as typing, writing, math, reading and the ability to use software programs” (Investopia, 2016).

While STEM subjects teach hard skills, that doesn’t mean to say that hard skills exist within only those subjects. Linguistics, for example, include hard skills and count among them knowledge of a foreign language (Enterprise, 2016), familiarity with vocabulary, phrase and grammar lists, and testing/test-taking tactics. Soft skills, on the other hand, are less tangible and more difficult to connect to certification. They can be self taught and self developed (Enterprise, 2016), including communication skills, work ethic, leadership skills and time management, or can be partly developed in the classroom (Dearborn, 2016), such as communication (again), critical thinking, problem solving, and creativity. While the teaching and learning of hard skills can be quantifiable, soft skills can be more difficult to assess.

When compared to the more hard skills-leaning STEM subjects, are soft skills-oriented liberal arts programs also important? Some call for the focus of education to be more on STEM, with Adkins claiming that the largest economy in the world, the USA, “desperately needs more STEM students” (Adkins, 2012), while listing examples of the hard skills that should be learned. Cohen (2016) finds that there is “a rising call to promote STEM education and cut liberal arts funding.” Not all agree with this view, however, and some scientists even claim that “the STEM crisis is a myth” (Charette, 2013), and that, instead, the liberal arts “‘softer’ broadly applicable skills such as oral and written communications and problem-solving skills are most important for college graduates to possess” (Ebersole, 2013). Ebersole references a survey conducted on behalf of Northeastern University, USA, that shows that a majority of business leaders believe these soft skills are necessary. Still, there is a feeling of “fuzziness” in the debate between “hard” and “soft”, as neither side refutes the need for the other, and some appear to try to take a middle ground, arguing for a balance to be found (Valchev, n.d.).

The aforementioned “balance”, however, suggests that the two skill sets need to be learned in suitable, or correct, proportions, indicating a mental or physical separation, much like the description of a balanced diet can tell us it should contain a balance of the different proteins, fats, carbohydrates, and necessary vitamins and minerals. This scientific view, while difficult to argue with in theory, may not hold intuitive meaning for many people, resulting in fewer people being convinced. To illustrate how, on the contrary, people can be successfully convinced (and staying with a food analogy), the British Dairy Council recommends that we drink milk as part of a balanced diet for the reasons of it being “a natural source of nutrients such as protein" (British Dairy Council, 2016a) despite their own analysis of the composition of milk revealing that, after water, sugar is the largest constituent part (British Dairy Council, 2016b), and not protein. The British Dairy Council is, I believe, promoting milk in a correct and convincing way, marketing a constituent that they see as one of the "essential ingredients", as focusing on the balance of sugar-to-protein-to-fat would only cause their main point of "overall, milk is good for you" to be diluted, hidden, or even lost. While a scientist or even a well-informed layman would be able to recognize that sugar is necessary part of any diet (and that, anyway, the sugar in milk is lactose, as opposed to the oft-vilified "table sugar", sucrose (Reuben, 2012), many regular people may not be able to "see the woods for the trees." It is these very people for whom the "milk is good for you" message is created.

The above example illustrates the problems with trying to show how things balance, instead of simply how the inclusion of an appropriate ingredient is important. It is the same with trying to balance STEM and liberal arts subjects, as an effort to make it obvious that a balance exists between the two (such as 80% to 20%, for example) would send an incorrect message (of the ratio of the ingredients, instead of simply how the inclusion of such ingredients is important). The point is that, while the skills learned in STEM are important and, concurrently, the skills taught by liberal arts courses are also vital, they need to be blended together in an almost imperceptible way so as to provide the learner with a well rounded, and useful education. How is that to be done? Enter STEAM.

2. STEAM Theory

2.1 An Educational Paradigm

John M. Eger, director of the Creative Economy Initiative at SDSU (San Diego State University) claims that new skills are needed as the demand for more creative and innovative workers increases (Eger, 2013). Eger (2013, p. 1) says that to accomplish our goals (of meeting the challenges of a global economy), we need to "reinvent our schools", modify "the very concept of education", and even "change the paradigm" that we hold. Florida (2002, p. 61) calls for fostering a creative class that can "engage in complex problem solving that involves a great deal of independent judgement", and goes on to explain that this will need high levels of education. This creativity is simply defined by Friedman (2005) as being "the quality or ability to create or invent something original". Therefore, the education needed will have to be different than what we have had until now in order to produce a different (i.e. original) result, compared to what has been seen until now. The task of creating a creative and innovative community, leading to a creative and innovative economy, needs "ingredients" that "nurture both sides of the brain" (1) (Eger, 2013, p. 3). While Eger talks about ingredients that are needed, these are not new, as-yet-undiscovered pieces. The pieces are the knowledge learned in STEM subjects combined with Art (as found in liberal arts), creating a new educational paradigm, that of STEAM (Science, Technology, Engineering, Art, Math). STEAM identifies the "role of the arts in educating for leadership and economic strength" (Duncan, 2010, p. 5), as an "arts education is essential to stimulating the creativity and innovation that will prove critical for ... competing in a global economy."

2.2 Conceptual Model

Education needs to provide "an environment in which students feel absolutely compelled to become involved" (Gigliotti, 1998, p. 3). This participatory aspect should expand the capacity for imagination (Radziwill et al., 2015), allowing a different world to be mentally created (and, at times, resulting in real-world creation), giving meaning to the STEM tools required (Cunningham, 2014). Instead of learning happening exclusively, or in effect, in an instructor-to-student chain of command, it should take into account the sociocultural perspective on learning (Moss, 2003). Moss (2003, p. 14) tells us that “learning involves not only acquiring new knowledge and skill(s), but taking on a new identity and social position within a particular discourse or community of practice.”

Radziwill et al. (2015, p. 4) proposed a (textual) model for STEAM learning, reproduced below with only slight adjustments.

Radziwill et al. (2015) model for STEAM learning

- Learning happens on four different levels:
  1. The accumulation of stocks of knowledge,
  2. The creation of flows of knowledge between people and organizations,
  3. The changing perception of self as new knowledge, skills, and one’s ability to participate in a community of practice are assimilated, and
  4. Other people’s changing perceptions of the learner as those new capabilities are leveraged within the context of a network.
- It presumes a creative ecosystem that necessarily crosses organizational boundaries. The organization becomes a custodian of talent, not a creator or originator of artifacts. Consequently, the organization has a responsibility to leverage its resources to maximize the benefits of the STEAM practitioner’s talent to society.
- Learning occurs over an irregular time horizon: not semesters, academic years, quarters or fiscal years, but moments and decades and lifetimes.
- Financial/career benefits may not be immediate, or may occur exogenously – i.e. outside the boundaries of traditional financial/career trajectories.
- Learning is emergent and not prescriptive. It requires that you ask questions which will enable you to develop your own direct and indirect measures for whether the experience was worthwhile.

Note that the STEM “hard skills” are clearly included at the first level of learning as “the accumulation of stocks of knowledge.” It is the knowledge flows, the perception of the self, participation in the community of practice, and other’s perceptions of the learner that are “soft skills” or results. Therefore, the STEAM educational paradigm exists in, produces and reinforces a hard skills and soft skills environment.

3. STEAM in Practice

STEAM has moved from being a concept developed by Yakman in 2006 (Steamedu, 2015) to becoming a mainstream framework for education in practice. Although initially evolving in the USA, it is now a globally accepted educational movement with, to give an Asian example, the Korean Ministry for Education making STEAM education one of their main implementation goals (Jho et al., 2016; Lee et al., 2013). Some practitioners are already using the concept in after-school clubs and summer educational camps (Eger, 2012). For the purpose of this research, the case of a STEAM camp in Europe, Designer Minds in Ireland (2016), was investigated.

3.1 Designer Minds – Case Study Content

Designer Minds “runs clubs and camps for children from 1st to 6th class (6 to 12 years old) who wish to explore STEAM” with the purpose of inspiring passion and using engaging hands-on activities and games, to “ensure that the learning process is ... entertaining and enjoyable”, in order to give children "a head start before entering the more disciplined environment of secondary school study" (Designer Minds, 2016). One such summer camp, running for one week in mid-August, 2016, is reported on here.

The week long summer camp ran for five days, from Monday to Friday, with parents or guardians dropping off their children at 10:00, and picking them up at 14:00. Children were signed in and out by parents/guardians. The classes had two experts in charge of teaching (and further experts were invited as necessary), and the children were assigned groups (of about three children) within which most practical work was to be done. Some children were interviewed at the end of each day (with the permission of, and in the presence of, their parents/guardians), and they had only positive things to say about the course, and explained how each day's topic and learning activity was different than the previous ones. Furthermore, at collection time, the enthusiasm of all the children was palpable. After the week of classes was finished, the children interviewed expressed their strong desire to attend the STEAM summer camp again in the future.

The content of STEAM in the Designer Minds summer camps is described in one of their listings (for the 2016 summer camp in Ballincollig, Cork, Ireland), reproduced below (Scamps, 2016).

Designer Minds STEAM 2016 Summer Camp

- **S** is for Science
  Children will participate in challenges, activities and design projects which will allow them to explore Biology, Physics and Chemistry in a fun and interactive manner.
- **T** is for Technology
  Children will produce a stop motion animation movie, always a favourite at Designer Minds camps. They will also explore augmented reality and be introduced to the basics of coding.
- **E** is for Engineering
  Kids will learn about the various types of engineers and complete engineering challenges using Lego and Minecraft.
- **A** is for Art
  Children will work on creative projects which will also be influenced by science, engineering and technology concepts.
- **M** is for Maths.
  Kids will complete maths challenges using Minecraft, and play games which will help them understand what computer programming is and how it works.
- When weather permits children will spend a little time each day outdoors. Children will participate in challenges, activities and design projects which will allow them to explore Biology, Physics and Chemistry in a fun and interactive manner.

It can be seen that the content list is a robust one, not shying away from including challenging topics. However, words such as "children" and "kids" are used, showing how the program designers have it foremost in their minds that the teaching methodology should be suitable for children, such as including games such as Minecraft (Mojang, 2016) to introduce and develop skills. Furthermore, the percentage breakdown of, or balance between, the five STEAM categories is not given, as discussed previously in this paper. Finally, the desire to take learning outside the classroom is also expressed.

3.2 Designer Minds – Student Feedback

Student feedback was collected by directly asking participants (in the presence of their parents/guardians), gauging the mood/atmosphere and recording comments made at the start and end of each day's session (when children enter, or are waiting for the doors to open, their enthusiasm could be judged and, on exiting the camp, parents/guardians generally asked how their day was, with children replying, providing collectable feedback), and reviewing online comments. It is beyond the scope of this paper to analyze comments deeply so, for the purpose of this paper, it will suffice to say that student feedback was overwhelmingly positive, with no instances of dissatisfaction recorded. Comments such as "I'm looking forward (to it)", and "I want to do this again next year" were frequent (Designer Minds, 2016).

4. Findings and Outlook

Proponents of the learning of STEM hard skills and those of liberal arts soft skills have sometimes been in disagreement about which skill sets are most important to learn. There have also been those who have argued that a balance between both types of skills needs to be found in order to provide a more appropriate education for students. However, the STEAM educational paradigm goes beyond that, with the concept being one of integration of STEM skills and Art skills in liberal arts, instead of balancing the skills against each other. In other words, education is improved when liberal arts and STEM subjects are taught together, with no clear distinction between the former and the current focus of the latter.

A case study of a STEAM educational one-week summer camp reveals that STEAM education has successfully moved beyond being a theory, and is now a proven success on the ground. Such summer camps have taught thousands of K-12 students in recent years (Grant and Patterson, 2016), so it will be interesting to watch how the STEM and liberal arts programs in secondary and tertiary education are enhanced to adapt to educational needs and expectations of children who have experience of this STEAM integrated education model.

Notes

(1) The author does not subscribe to this one-side-science, one-side-art theory of the brain. The quote is included to indicate "nurture in a more even way" for the purpose of this paper.

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