Top Future Skills in Cross-Disciplinary Design Education

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Abstract
Cross-disciplinary education is increasing in popularity. According to the World Economic Forum report, “The Future of Jobs”, the top skills in the future will be complex problem solving, critical thinking, and creativity (Forum, 2016). Universities expect graduates to be leaders and innovators in the workplace and society (Gross & Do, 2009). Are Design Schools currently cultivating skills such as those mentioned above? Attempting to answer requires an examination of the design education at present. We analysed the core values and design pedagogy of the world’s top ten design schools ("QS World University Rankings by Subject 2018,"), as presented through the respective websites of these schools. Our exploration provides an overview of the varying approaches to design education. The primary purpose of this study is to determine how aligned are the leading design schools with the projected top future skills. This work contributes to an understanding of the cross-disciplinary design pedagogy in the world’s leading design schools, as communicated through their publicly accessible, online prospectuses.

Keywords: Design education, design schools, skills

Introduction

It is argued that we face a systemic failure in leadership today and as such, a societal change is crucial. (Dean,2015). It is also suggested that a new generation of passionate designers is emerging. This generation desires to match its talent with a world desperate for solutions (Lawrence, 2014). There are many significant challenges in the world. We do have the tools to help solve them. (Dean, 2015). Design schools and universities around the world are now shaping the minds that will address those challenges. Universities expect graduates to be leaders and innovators in the workplace and society (Gross & Do, 2009).

Simultaneously, increasing demand for a capable workforce of creative problem-solvers is underway. This workforce exhibits the ability to produce bolder, meaningfully grounded, effective ideas (Lawrence, 2014). The quickly emerging, a new generation of creative leaders is eager, energised, and enthusiastic to grow personally. They are looking forward to creating change. They often struggle to integrate into organisations. Ironically, many corporate executives and employees of an older generation, struggle as well to utilise this young talent and to harness its energy (Dean, 2015). There are also challenges in design education. Although technical skills should remain at the core of design education, soft skills such as empathy, collaboration, and leadership are the most important (Hardin, Westcott, & Berno, 2014).

Context

Nixon (2014) points out that formal degree curricula generally lag industry by ten years. Another remark from the same author is a mismatch between business managers and designers. Business managers do not learn design and designers do not receive business training which creates a knowledge and communication gap between the two fields. Such an issue indicates that changes in education are needed.

The World Economic Forum is a Geneva-based, international organisation with the mission to "*engage foremost political, business and other leaders to shape global, regional and industry agendas*". The Forum published in 2016 the report "the Future of Jobs" in which it claims that the top (three) future skills will be complex problem solving, critical thinking, and creativity (Forum, 2016). These skills are defined below.

2.1 Research Questions

We raise two questions in this study. R1. Are the world's leading design schools promoting the top future skills to students? R2. Which skill(s) is promoted the most? R3. Which future skill(s) is the least promoted?

2.2 Working Definitions

Interdisciplinarity "includes an interaction, sharing of insights, overlapping or bridging two (or more) disciplines from a practical-outcome, problem-oriented or theoretical approach. It applies or borrows tools between various subjects. Interdisciplinarity may lead to the emerging of new fields of knowledge and a new discipline, as it unifies and integrates knowledge (Franks et al., 2007).

Multidisciplinary is positioning of each discipline (their associated knowledge, frames-of-reference, approaches, methods, accepted practices) alongside one another; the fruits and their position are distinct and separate. (Self, Evans, Jun, & Southee, 2018)

Complex problem solving is referring to resolving issues that are complex by their nature. Dörner & Joachim (2017) define the complex problem as an Ill-defined problem that has no apparent problem definition. The goal state is not clearly defined, and the means towards the goal state are not clear either. The authors mention as an example the Israel-Palestine conflict as a complex problem. The goal state for solving this political conflict is not clearly defined, and even if the conflict parties come to an agreement and accept a two-state solution, such a goal would leave many issues unresolved.

Problem-solving (without any reference to it being complex) has been defined in many ways, as there are multiple angles one can tackle problems. Issues arise when some use the term "design" and "problem-solving" interchangeably (McCade, 1990). The working definition that we adopted for this study is from Britannica Encyclopaedia ("Problem Solving," 2018) which defines the concept as "process involved in finding a solution to a problem".

In academic, university environments, students are expected to read critically and to think and use logic while solving complex problems (Rotherham & Willingham, 2009). Assuming that complexity is one more factor to consider about upon the problem-solving procedure and taking in consideration that the skills that we examine in this paper are inseparable, we investigated two terms "Complex problem-solving" and "problem-solving". We did not find much evidence of "complex problem-solving" being taught. However, upon examining the wording "problem-solving", we have seen plenty of material.

Creativity is a concept that can be understood when it is clearly defined. In this paper, we operationalise the definition of Creativity by Runco and Jaeger, in which originality and effectiveness (or usefulness) are required (2012).

Content Analysis Methodology

In this study, content analysis is the primary methodology. Content analysis is a flexible, systematic and rigorous approach to analyse documents. It is a research technique that helps us to make replicable and valid inferences from texts (Krippendorff, 2013). There are six components in content analysis. The first four can be summed up as *data making*. These are *unitising*, *sampling*, *recording*, and *reducing data*. The fifth component is *abductively inferring the data*, and the last one is *narrating*.

Unitising is systematically distinguishing segments of text that are of interest for our analysis. In this study, we only looked at the publicly accessible, textual representation of the selected institutions. We were looking for the skills developed and taught by these institutions, more specifically on creativity, problem-solving, and critical thinking skills. All the texts come from on the official websites of the

institutions, mostly through their "About" page or a similar introductory page. In some cases that we did not find information about the skills developed and taught, we collected Strategic plans and downloadable prospectuses in PDF format, if such documents were available. *Sampling*. We only look at the top 10 institutions on the QS World University Rankings 2018, at the "Arts and Design Rankings". Perhaps this is one of the most prominent university rankings that also publishes what methodology was used to determine the ranks and is specifically looking at art and design schools.

Recording

To preserve the text in its original form and prevent any possibility that it may change throughout this study the text from each university was saved separately.

Reducing

To avoid any duplicates and to narrow down the material we had in hand, we focused on the text that gives a good understanding of the skills developed and taught by these institutions. We eliminated any text that focuses on any individual from a faculty or to any individual program or degree or facilities.

Abductively inferring the data

In this stage, we examine contextual phenomena. The working definitions are used as *analytical constructs* (also called rules of inference) to help us move from the text to answer the research questions. There are two logically independent domains; these are the text and the context. When inferring the data, we are concluding one independent domain (the text) to the other (the context) (White & Marsh, 2006).

World's Top Design Schools

In this study, the world's top design schools are determined by the QS World University Education Rankings, by "Arts & Design" subject ("QS World University Rankings by Subject 2018," 2018). The table below indicates the schools by ranking, as well as their location, degrees offered and the web address of each school.

Table 1. World's Top Art & Design Schools

Rank	Name of Institute	Department	Location	Degrees Offered by the Institution	URL
1	Royal College of Art (RCA)	School of Design	London, UK	GR, PhD	https://www.rca.ac.uk/schools/school-of-design
2	The New School	Parsons School of Design	New York City, USA	UN, GR	https://www.newschool.edu/parsons
3	Rhode Island School of Design (RISD)	-	Rhode Island, USA	UN, GR	https://www.risd.edu
4	Massachusetts Institute of Technology (MIT)	Design Lab	Massachusetts, USA	UN, GR, PhD	https://design.mit.edu
5	Politecnico di Milano	School of Design	Milan, Italy	UN, GR, PhD	http://www.design.polimi.it/en
6	University of the Arts London (UAL)	-	London, UK	UN, GR, PhD	https://www.arts.ac.uk
7	Pratt Institute	School of Design	New York City, USA	UN, GR	https://www.pratt.edu/academics/school-of-design
8	School of the Art Institute of Chicago (SAIC)	-	Chicago, USA	UN, GR	http://www.saic.edu
9	Aalto University	Department of Design	Helsinki, Finland	UN, GR, PhD	http://design.aalto.fi/en
10	Stanford University	d.School	Stanford, USA	UN, GR	https://dschool.stanford.edu

Six schools are in the USA; two are in the United Kingdom, one in Italy and one in Finland. All schools speak predominantly English except two (in Italy and Finland). About half of them offer research degrees in PhD level, and all of them are in the Northern Hemisphere, in just two continents, Europe and America. Only three carry the "Arts" in their title, whereas eight carry the "Design" in the institution or departmental name.

Keyword Research Pilot-Study

Google was used to determine the frequency of certain keywords on the websites of each school. Each school was separately examined to identify how many times the keywords "Creativity", "Complex Problem Solving" and "Critical Thinking" occur. These terms correspond to the skills that we are particularly interested in this study. Additional terms with similar meaning were also examined such as "Innovation", "Design Thinking" and "Problem Solving". All searches were performed in quotation marks to eliminate disconnected words. Searching in quotation marks returns results with the exact word combination. For instance, in the case of design thinking, if a page had the word design and the word thinking but not as the word group "design thinking" this page was not included in the search results, as we explicitly instructed Google to return only connected, combined word.

Table 2. Google hits of selected terms, as of September 10, 2018

Rank	School	Domain Searched	Creativity	Innovation	Design Thinking	Complex Problem Solving	Problem Solving	Critical Thinking	*SUM*
1	School of Design - Royal College of Art (RCA)	https://www.rca.ac.uk/schools/school-of-design	428	415	303	0	4	1	*1151*
2	Parsons School of Design -The New School	https://www.newschool.edu/parsons	155	272	75	0	58	35	*595*
3	Rhode Island School of Design (RISD)	https://www.risd.edu	155	223	116	0	86	195	*775*
4	Design Lab - Massachusetts Institute of Technology (MIT)	https://design.mit.edu	1	89	7	1	0	3	*101*
5	School of Design - Politecnico di Milano	http://www.design.polimi.it *	39	196	63	5	24	3	*330*
6	University of the Arts London (UAL)	https://www.arts.ac.uk	3960	4120	143	2	292	175	*8692*
7	School of Design - Pratt Institute	https://www.pratt.edu/academics/school-of-design	19	6	2	0	5	3	*35*
8	School of the Art Institute of Chicago (SAIC)	http://www.saic.edu	408	408	51	0	116	116	*1099*
9	Department of Design -Aalto University	http://design.aalto.fi *	50	179	94	0	5	-	*328*
10	d.School - Stanford University	https://dschool.stanford.edu	44	300	226	0	17	2	*589*
			5259	*6208*	*1080*	*8*	*607*	*533*	*SUM*
			526	*621*	*108*	*1*	*61*	*59*	*Average*

*Politecnico di Milano and Aalto University are the only two institutions in which the default language on their websites is other than English.

This pilot study is not highly conclusive (for various reasons) and cannot be the primary source for substantial findings. Nonetheless, it overall indicates how frequently the websites of those institutions communicate certain concepts. Perhaps these indicators may show the focus of those institutions or maybe give hints of the overall relative importance of these terms. The table can be viewed by row and by column.

The column indicates the number of skills mentions by the school that corresponds to each column. For instance, UAL has the highest frequency of "Problem Solving" mentions. The row indicates which skill is the most popular on the website of a given school. For instance, MIT appears to be talking mostly about innovation. Numerically speaking, the web pages of MIT that are indexed by Google mention Innovation 89 times more than what they do of Creativity. Innovation is the most popular term in most cases.

UAL, an art school from London, has the most "Innovation" mentions. RCA which is another art school from London comes in second. The same schools share the same ranking in "Creativity". Perhaps it is coincidental that UK schools top these mentions in our list. It is also a possibility that the UK has a developed a digital culture where schools ought to generate content and provide news, blogs and other pieces of content, which subsequently is indexed by Google and provide the results shown above.

Another observation is that “Complex Problem Solving” is almost not mentioned at all. Removing the “Complex” and looking upon “Problem Solving” without the complexity factor, we can see that there are significant mentions but not as many Creativity and Innovation which are the most popular terms. A thought-provoking remark is that UAL and SAIC (both are art schools) have the most mentions of problem-solving, which could mean that design schools do not address those skills as much as art schools (this is only a hypothesis, not a finding). Besides Parson and RISD other schools do not have significant remarks on problem-solving which indicate that it is not a popular term.

On the term “Critical Thinking” the art schools of UAL and SAIC have notable mentions. RISD carries the most mentions. Besides these three schools, there are no significant mentions elsewhere. Similar to “Problem Solving”, “Critical Thinking” appears to be not very popular.

A significant restraint in this pilot study is that Google partially indexes information and occasionally excludes information. For example, Pratt Institute would appear as a poor performer with only three mentions of “Critical Thinking”. Upon looking at the “Undergraduate Bulletin 2018-2019” document that is available from the site in PDF format, we can see that critical thinking was mentioned 14 times in that document.

Therefore this pilot study does not provide a very detailed, in-depth understanding of the situation. We use it to examine whether these concepts are mentioned in the first place and obtain a basic idea of which skills appear more often in the texts from the institutions. No conclusive finding can be drawn. Perhaps a substantial finding from this pilot study is that as University of the Arts London has the most search engine results, it is the most content-rich and web-optimised school thus the depth of the site makes it more likely to have organic traffic, compared with the other websites. This finding is not highly relevant to this study though.

Profile of the World’s top Art & Design schools

This section provides a brief presentation of each school. Also, there is a brief description of the Creativity, Problem-solving and critical thinking skills by each school as well.

1 Royal College of Art claims it is the world’s oldest Art and Design University in continuous operation. It offers only post-graduate programs, and it encourages interdisciplinarity. It aims to advance art and design education. One of the goals of the institution is to create new knowledge in art and design through research and scholarship. (Royal College of Art Strategic Plan, 2016–21, 2016).

Creativity is at the core of the RCA research. There is an emphasis on innovation as well.

Problem-solving and critical thinking are mentioned numerous times in the news section of the website. However, they do not appear to be prominent concepts in the textual representation of the school.

2 The New School Parsons Parsons acknowledges the interdisciplinary nature of problem-solving in contemporary society. They offer practice-based, collaborative learning through a range of university disciplines. The school is leveraging to a diverse faculty as well as to the New York City which is home to a robust ecosystem with creative practitioners and industries. They do challenge conventional thinking.

Parsons integrative curriculum is helping students to elevate their creativity skills. Critical thinking and problem-solving are core values embedded in the vision of the school. The school strives to produce critically engaged citizens, dedicated to solving problems for the public good.

3 Rhode Island School of Design (RISD) RISD Pushing the individual limits of each student while applying a critique culture is at the core of the RISD philosophy. They promote entrepreneurship and support critical thinking. The institution advocates adding art and design to the STEM (Science, Technology, Engineering, Maths), to foster innovation. Flexible thinking, risk-taking, to solve pressing challenges from urban revitalisation to global warming.

Creativity, Problem Solving and Critical Thinking are skills that are mentioned explicitly through the RISD website and ingrained in their curriculum.

4 Massachusetts Institute of Technology (MIT) MIT Design Lab is deeply rooted in technology. Design is taught from a lab and not from a school. Therefore it appears to be leaning more to scholarship and criticism than teaching the hard design skills. They do multidisciplinary research with critical reflection. Their approach to problem-solving involves redefining the question/problem statement first.

Problem-solving and critical thinking are aligned together at the Design Lab. The lab is challenging the status quo and given assumptions with ongoing critical reflection. They do not only focus on problem solving, but also on “problem making” skills. Creativity is indirectly mentioned, and it does not appear to be a core component of their curriculum.

5 Politecnico di Milano Milan is a city with a long design practice tradition which derived from the material culture of craftsmanship that the region of Lombardy has had since the beginning of the last century. A meeting point for different cultures, the school has a constant desire to experiment with innovation and experimental development lines to match the real market needs of contemporary society. All courses deploy a multi-disciplinary approach to design.

Creativity appears to be present from an artistic angle. It is unclear whether problem-solving and critical thinking is taught, due to lack of information in English.

6 University of the Arts London UAL is a group of 6 renowned colleges. Each college has a different domain-specific focus, even though there are commonalities among the colleges and they share the same strategy. A large body of students with 18 thousand individuals from 130 countries provides multi-culturalism which is a core strength of the university.

Creativity is well embedded. UAL is using teaching methods based on the best creative practices and is adapting the methods accordingly to ensure that their students will possess future-proof skills in their future careers. There is little evidence that UAL is teaching problem-solving skills. Curiosity, making and critical questioning are at the core of the curriculum; thus, Critical Thinking skills are in the curriculum.

7 Pratt Institute

The school is confident about its competencies and is proudly being part of the New York City, a multicultural world centre for arts, culture design and business. The curriculum is interdisciplinary and promotes creative strategies for design thinking. The school aims to develop the students with professional competences, including establishing a critical judgment and historical perspective. The school believes that these skills will equip students with the right tools and mind to become creative problem solvers.

Pratt Institute is devoted to the transformative power of creativity. Problem-solving is a core component of the foundation year while critical thinking with deep understanding develops throughout the entire curriculum.

8 School of the Art Institute of Chicago: SAIC

SAIC advocates self-directed study curriculum with interdisciplinarity as a core value for exploration. Critical thinking, rigorous investigation and creativity are well ingrained in their core values too. Critique is also a fundamental component of their curriculum.

Creativity is well ingrained in the curriculum. Problem-solving is not explicit on the text. Therefore it is unclear whether they teach it. Critical thinking seems integrated well in the curriculum.

9 Aalto University

Aalto university puts a greater emphasis on humans though technology-driven thinking and interaction among different disciplines. It claims that it is a meeting point where science and art meet business and technology, it is an institution with a human-focused, user first philosophy.

We did not find mentions of creativity; however, it appears that the university strives for novelty. Problem-solving is not stated either, yet; it seems to be present. Critical Thinking is offered by placing students to think of new artistic and scientific ways of seeing the world.

10 Stanford University

A school with a wide-open policy, welcomes anyone to join and become an innovator. Interdisciplinarity is deeply rooted here, as the school serves Stanford students regardless of their major or discipline. Their inclusive approach aims to help people

unlock their creative potential and apply it to all kinds of problems, including messy and complicated issues.

Creativity is embedded very well in the d.school curriculum. Problem Solving is at the core of the projects that the d.school students are working on, as all projects come from the real world and are not student assignments, they are actual problems. Critical Thinking appears not to be part of the curriculum.

Table 3. Skills taught, as observed by their publicly accessible online prospectus. September 14, 2018

Rank	School	Creativity	(Complex) Problem Solving	Critical Thinking
1	School of Design - Royal College of Art (RCA)	Taught	Unclear	Unclear
2	Parsons School of Design -The New School	Taught	Taught	Taught
3	Rhode Island School of Design (RISD)	Taught	Taught	Taught
4	Design Lab - Massachusetts Institute of Technology (MIT)	Taught	Taught	Unclear
5	School of Design - Politecnico di Milano	Unclear	Unclear	Unclear
6	University of the Arts London (UAL)	Taught	*Seems not taught*	Taught
7	School of Design - Pratt Institute	Taught	Taught	Taught
8	School of the Art Institute of Chicago (SAIC)	Taught	*Seems not taught*	Taught
9	Department of Design -Aalto University	Unclear	Seems taught	Taught
10	d.School - Stanford University	Taught	Taught	*Seems not taught*
		8/10	*5/10*	*6/10*

Conclusions & Discussion

In this section you can read the main conclusions of this study. Limitations of the study are further below. The paper concludes with two suggestions for further, future research.

Main findings

Creativity is the top promoted skill, and it integrates well across the board. Every single English-speaking institution has creativity in their texts. Critical thinking is also encouraged by a little over than half of the institutions. Complex problem-solving appears to be missing entirely. We failed to find any reference to the exact wording "critical problem-solving". Nevertheless, upon looking at "problem-solving" without any reference to complexity, we can see that about half of the schools advocate problem-solving. Many schools are aware that this skill is a definite asset for their students, and the lack of any reference to complexity may worth further investigating.

Creativity appears to have a similar connotation across all universities (with usefulness or novelty mentioned at times) even though slight nuances emerge, depending on the university. For instance, MIT is a school with a solid foundation in engineering, and it seems to have a definition of creativity that is leaning towards innovation whereas some art schools seem to lean towards inventiveness or imagination. Overall, creativity does appear to have a meaning that is analogous to our working definition.

Critical thinking appears a looser and more unrefined concept throughout the texts examined. For instance, RISD labels it as “Critical Making”, and it correlates it with craftsmanship, whereas Aalto University encourages the freedom to be creative and critical. Parsons and Pratt Institute, on the contrary, promote critical thinking as independent skills. We can observe that the same concept slightly varies from institution to institution.

Perhaps the variety of definitions may be attributed to the fact that many and design schools are operated independently without seeing any analogy of themselves with any academic counterparts (Abel, 2013). It is understandable that different schools are aligned towards their specific area of expertise and approach the same concept from a slightly different angle. Different angles provide multiple perspectives and make the field deeper. However, it is crucial to have a common ground with solid definitions. For instance, problem-solving has many definitions (McCade, 1990) which makes it possible that the universities may refer to different meanings of a similarly labelled concept. Such phenomena make this study more difficult but also more critical and relevant.

Another finding in this study is a great emphasis on interdisciplinarity and cross-disciplinarity from multiple colleges. Sarah Stein Greenberg (2014), an educator from Stanford University argues that the world is changing rapidly, and it is possible that the skills students receive now may become outdated quickly within a few years after students graduate. Educators ought to prepare students adapting to new circumstances over their lifetimes. This skill is labelled as “adaptive learning” in Stanford (Greenberg et al., 2014). The world’s top design universities are exposing their students to multiple educational experiences, providing a rich-learning environment.

Limitations of the study

A significant limitation of this study is that the website or the prospectus of an educational institution may not necessarily reflect the program content and what courses they teach. It is possible that a university aims to attract prospective students through these pages and as such they portray an optimistic idea that is relevant to fresh school graduates. Judging an institution from its promotional material is perhaps superficial because we only see the image that the university wanted us to see. Thus this information may be fundamentally biased. Judging module syllabuses or course handouts would have been ideal. However, this information is publicly available for all universities.

A reflection that we must mention in regards of the textual analysis that we performed is that we have been looking for specific strings of texts or their synonyms, such as creativity, complex problem solving and critical thinking. The issue with this approach is that we are looking for precise terminology and we may have misjudged some institutions due to the colourful complexity of words having multiple meanings. For example, a school may be teaching problem-solving skills, and they have been labelling the same skill as analytical thinking. Therefore we may have missed it with the method that we pursued.

Another issue is that of the temporal nature when surveying websites. As websites continuously adapt to new circumstances and frequently change with dynamic content, our observation in this study is temporal. That means our findings now may be incorrect shortly. For this reason, this study only assesses the situation as is, at the time of publishing this paper.

Another problem that we ought to mention is that of the QS World Ranking List. The theme examined is Art and Design. Art and Design are two separate domains with different characteristics and motives, even though they share some commonalities. That means it is -somewhat- flawed to consider this list as the list of the world's top design schools.

Suggestions for future studies

This paper presents an initial, exploratory study. There are many possible directions for future research. In this section we offer two suggestions for future studies, the first one is to pursue a more extensive look at complex problem-solving in design education. The second one regards design being as an academic discipline.

Complex problem-solving in design education

As we are facing many complex problems in the world today, it takes more than just troubleshooting to address complex issues. It is possible that universities are tackling complex problem-solving through an interdisciplinary approach or perhaps complex problem-solving skills are fostered through design thinking. A more in-depth, more extensive study could provide more insights in this area.

Design as an academic discipline.

About half the world's top art and design schools offer a PhD program. PhD studies may imply a particular type of skill-set, that can include skills such as project management, knowledge and information or communication skills. Some argue that design is as a hands-on, practical skill. At the same time, design is also emerging as an academic discipline. It may worth investigating whether the schools that offer PhD studies in design are promoting a different skill-set to their design students, compared to schools that have been traditionally teaching design as an applied arts and crafts discipline.

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