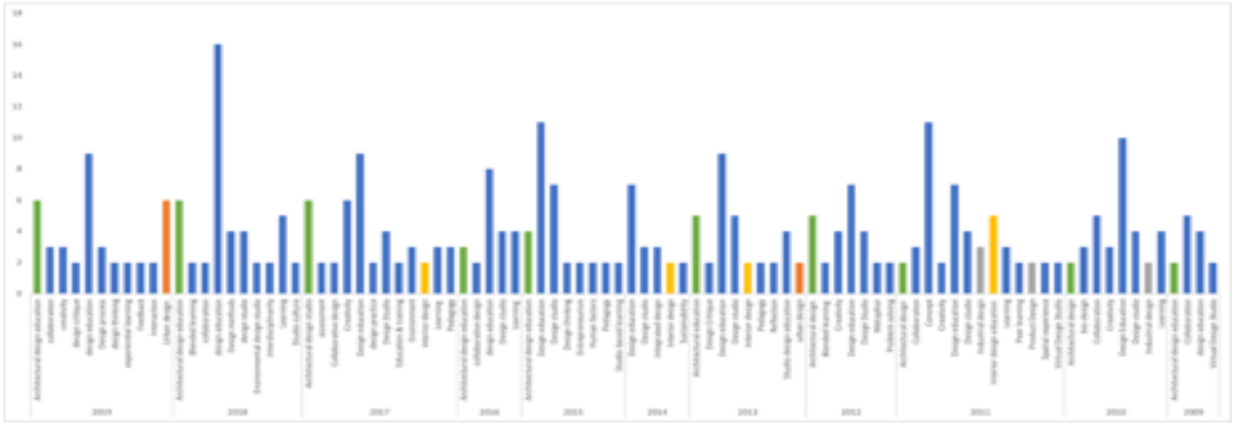
Journal of **design studio**



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Journal of **Design Studio**

Journal of Design Studio is a peer reviewed journal published two issues per year, **July** and **December**. Journal of Design Studio is an open access electronic journal. There is not a publication charge. Articles appeared in the journal cannot be used, whole article or in part, without proper referencing.

The journal aims to publish scientific articles based on design studio education of different disciplines, especially in architecture, interior design, urban design, industrial design, communication design, graphic design, fashion design and all other design disciplines.

In addition to publication of scientific papers, the journal may include good studio practices and book reviews in the field.

All articles in the journal are subject to two peer reviewers evaluation, all articles can be published after publishing decision of this peer review process.

AIM

The aim of the Journal of Design Studio is bringing different design studio researchers together on a multidisciplinary design studio research platform. This design studio research platform gives the researchers who made experimental studies in their design studio education to share their works with the other researchers in the same area or similar research fields. The scope of the Journal of Design Studios include all research and experimental works realized in all type of design studios.

SCOPE

Design studio pedagogy,
Design theories and methods for studio works,
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Design principles for studio work,
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Journal of **Design Studio**

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Contents:

Editorial

Orhan Hacihasanoglu
Faculty of Architecture and Design, Özyeğin University, Istanbul, Turkey

Refer: Hacihasanoglu, O., (2019), Editorial, Journal of Design Studio, V:1, N:2, pp 3-4

Editorial

The second issue of Journal of Design Studio covers two research articles. The first one is entitled as "Teaching Virtual Reality and Immersive Design, How should immersive design be thought ?". The article was written by Can Bora Sezer who is actively working in Özyeğin University, Faculty of Architecture and Design, Department of Communication Design. He made a research to find the answers of following two questions. "*How immersive virtual environments are designed?", " How should Immersive Design be taught ?".* The conclusion of the paper covers the idea of interdisciplinarity in learning and teaching processes and environment. The second article of this issue is entitled as "Terms and Concepts on Design Studio in the Research Articles of the 2010's" written by İlgi Toprak and Orhan Hacihasanoglu. The article based on a research to find the tendencies in design studio research articles in the last decade. The article tried to find the terms and concepts which were changed according to tendencies in research studies on design studio. To make this research they preferred to to use articles in the journals which are indexed by SCOPUS in the last decade between 2008-2018.

Journal of Design Studio is now indexed and listed in the following organizations *GoogleScholar, Ideal online, Scientific Indexing Service (Sindexs), World Catalogue of Scientific Journals.* The editors work on other indexing services and some in evaluating or pending position like Avery Index to Architectural Periodical, Design and Applied Arts Index.

Editors of Journal of Design Studio published a call for abstracts in this issue and social media. Please follow Journal of Design Studio in Facebook, Linkedin and Instagram. The special file for the Volume 2 No 1 July issue of the journal "integration-in, to, with, for, by-design studio". Theoric studies, technical issues, professionals, actors in design studio, integration of representation techniques, technology, new approaches are the possible subjects of special issue. The deadline for sending abstracts of 1000 words to editor@journalofds.com will be February 10th 2020.

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Abstract: Maximum 1000 words abstract including maximum 5 keywords and a suitable title.

deadline for abstract submission February 10th 2020

deadline for article submission May 10th 2020

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Journal of
Design Studio
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Teaching Virtual Reality and Immersive Design

How should immersive design be taught ?

Can Bora Sezer
Özyeğin University, Faculty of Architecture and Design, Istanbul, Turkey

Received: December 15th 2019, Accepted: December 27th 2019
Refer: Sezer, C.B., (2019), Teaching Virtual Reality and Immersive Design, Journal of Design Studio, V.1, N.2, pp 5-11,

Abstract: This Study aims to develop an elective Virtual Reality and Immersive Design Course (VR & Immersive Design) for the spring 2019 term by the Architecture and Design Faculty, Communication Design (COD) Department in Istanbul Özyeğin University. The Communication Design department has an optional Game Design path for its Final year - senior students and this course aligns with the said path. The research mainly focuses on the interdisciplinary aspects of creating virtual worlds and defines teaching methods, course content and course goals along with assigning individual tasks to different students with various interdisciplinary backgrounds as team members. Overall this paper examines the following questions;

How immersive virtual environments are designed? How should Immersive Design be taught?

Keywords: Education, Virtual Reality, Immersive Design, Interdisciplinary, Game Engines

Why a Virtual Reality Design course is necessary?

Oxford dictionary defines Virtual Reality (VR) as "the computer-generated simulation of a three-dimensional image or environment that can be interacted with in a seemingly real or physical way by a person using special electronic equipment, like a pair of glasses with a screen inside or gloves fitted with haptic sensors."

Currently VR is quickly becoming a huge area of technology, with giants like Apple, Facebook, Microsoft and Google competing to provide the next big VR experiences. Statista predicts that the worldwide user base for VR will reach 443 million by 2025, meaning that it is becoming increasingly important for designers and Design students to know how to create VR experiences. Creating Virtual immersive experiences require completely new ways of thinking about design and questions how well we are equipped to tackle this new field of design? Businesses are already hunting for people who understand how to design technology and experiences for the new VR medium. This course will make it possible for students to gain skills and become leaders in applying VR in near future. With filmmaker Steven Spielberg's science fiction and adventure movie "Ready Player One," narrating an immersive virtual universe (March 2018), Virtual Reality has finally passed to popular culture. Furthermore, statistics regarding VR usage in Universities show that; In our present day 18 Students share one VR headset compared to 6 months earlier when 51 students shared one VR headset. The amount of VR headsets per university has folded 4 times regarding this time frame. Every 4th university is collaborating in VR projects regarding Psychology, History, Cinema and Healthcare along with the predominant gaming and education fields. 79 percent of universities own at least one headset. (vrfirst.com, 2017)

VR and interdisciplinarity

VR and Immersive design is an interdisciplinary territory. Addressing modern academia it mainly covers the fields of Architecture, Industrial design, Communication Design and Computer engineering. Basically, Immersive environments require *space* to move in, *objects* to interact with, *3D interfaces* and *programming* to function.

The interdisciplinarity of VR is parallel with a similar trend in the design practice itself. Pares (2001), a well recognized VR researcher, puts forward that there are three basic forms involved in VR activities: The first one is *explorative*, the activity of navigating in virtual environments. The second activity is *manipulative*, the action of interacting with virtual elements and objects and the third activity is *contributive*, the ability of modifying and constructing the surrounding environment. These three basic forms of virtual activities correlate directly with the Spatial (space), material (object) and Visual (image) manifestations of the design domain. The design artefacts of Spatial, material and Image are of course related to Architecture,

Industrial Design and Communication design with the exception that Communication Design is not only responsible for the "Image" as in Graphic Design but also represents building "interactions". All these departments exist under the Architecture and Design Faculty and offer a value to the course creating an absolute productive platform

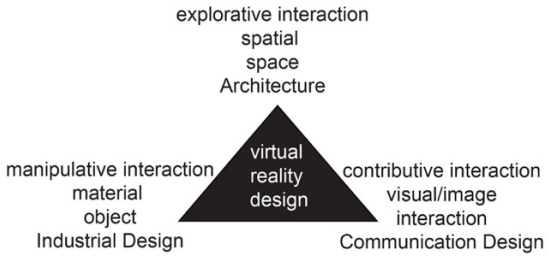

Figure 1. Virtual Reality Design Course and its relation with design departments.

Besides the Architecture and Design faculty, VR has a relation to the Computer Science under the Engineering Faculty as well since the creation of Virtual Environments include advanced programming.

Related literature on Teaching VR design emphasising Interdisciplinarity

Following extended research for papers concerning teaching virtual reality, a trajectory of the topic of developing VR courses surfaced. Literature shows that one of the first papers related to the interest of teaching VR belongs to Bell (1996) who was the first to study the creation of a VR course. His course focused on teaching VR concepts more than implementing VR applications due to the lack of expensive VR hardware at the time. After this came Burdea (2003) who refers to limitations like; scarce literature surrounding the topic, the lack of specialised VR Labs and inexperienced lecturers. He remarks the upcoming market for the utilisation of VR technologies and points out to the demand for such a course in relation to the expanding job opportunities regarding VR specialists. Claiming VR education has been deficient at the university level Burdea also stated that it cannot be taught adequately without specialised laboratories. The international survey Burdea did in 2003 showed that only 148 of universities offered a virtual reality course and 273 universities later in 2008. Today with the advancements in technology many more VR courses have been established mostly taking the form of lectures and practical approaches. A high percentage of the existing courses are provided to computer science students with the intention of consorting computer vision. However, it is solemnly understood that in recent years this teaching methodology is changing towards a more interdisciplinary trend for its better project outcomes.

There are several factors involved in VR besides computer science; Physiological responses, usability, UX design, and interaction design are some of them. In this light, technicality, human characteristics and design should be treated with equal importance in VR education. All of the following researchers indicate the importance of interdisciplinary teamwork;

Miyata et al (2010) have put in place an educational framework to develop VR applications in which graduates work in interdisciplinary groups to create VR environments. Besides improving collaborative skills, students are motivated to learn more given the competition among groups. The application ideas to be worked on are asked to be thought by the students themselves. This way each project has a different focus point. This method seems to have excellent results in student learning and creativity. Häfner et al. (2013) also presented the formation of their VR course stating the importance of different skills working together and emphasising interdisciplinary teamwork within VR projects. Häfner et al. expressed that student group formation and task specification design are key factors for a successful VR course project, and that students should have the freedom to be creative.

Zimmerman and Eber (2001) one of the first among suggesting interdisciplinarity among VR courses, describe the course as giving lectures on both programming and artistic topics, group laboratory sessions, research arrangements and demo presentations. Over the course, each group becomes responsible of creating a collaborative virtual environments using special software and Headsets. Herbelin and Cíger (2008) also argued that most of the courses labelled as virtual reality systems are almost exclusively on visual computer graphics and design and so besides the technical development, their student workshops about VR almost always focuses on immersion design rather than computer programming only. Stansfield (2005) offered her VR course as an elective 400-level capstone course. She argued since Virtual Reality is such an extensive field of study, the planned course should provide a multidisciplinary environment ideal for the incorporation of capstone students, allowing them to joint learned experiences during their undergraduate years.

In summary, the literature relating to teaching virtual reality courses demonstrate the importance of the multidisciplinary nature of VR. The field involves a broad array of technical, human and design aspects. Among the VR courses reported, most include teamwork in which VR applications are developed by students with different backgrounds.

Lab Space and Equipment, Software and Tools
The current OZU VR Lab (B41) established by the Architecture and Design Faculty established in May 2018, consists of a 50m2 space with 4 MSI Aegis 3 VR compatible computers and a HTC Vive headset. The base stations have been installed correctly as a 15 m2 room scale setting and the headset has been tested and is operating well.

Beside using 3D modelling programs and programming skills Virtual Environments require knowledge for Game Engines. In that respect the newly developing field of Immersive design is dependent on game development platforms because it relies on the tools and software provided by the game Industry. Game developer companies in the video game industry use private, self build game engines. These are software environments designed for video game developers used to create games for various platforms like computers and smartphones. The game industry and the tools they provide are often underestimated by academia's intellectual but it shouldn't be forgotten that in 2017 the game industry has surpassed the cinema industry in size and revenues. Besides that International technology companies use commercially available game engines in most of their projects. Microsoft, for instance, uses the Unity game engine for its augmented reality Hololens projects and National Aeronautics and Space Administration (NASA) relies on Unreal Game Engine for its immersive space simulations applications to study human performance in space.
Only a few commercially available game engines exist for building immersive environments, Here are the most well known commercially available game engines;

1. Unreal Engine founded in 1999 in North Carolina by developers from all over the world.
2. Unity game engine, founded in Denmark in 2004 which moved to San Francisco in 2009.
3. CryEngine by Crytek, established in September 1999 Germany, (founded by Turkish Yerli brothers)

About the game engines OZU VR Lab and other Turkish Universities prefer

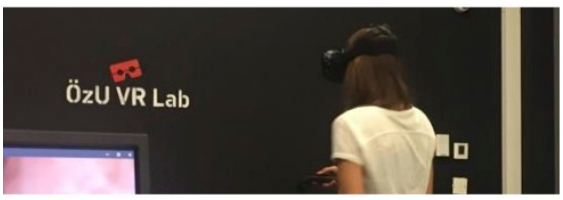

Figure 2. OzU VR Lab

Currently in Turkey (May, 2018) there are 4 academic VR labs in total. All of these labs except OZU VR Lab have been established with the help of VR First. VR First is a subdivision that belongs to the Turkish/German Crytek gaming company promoting facilities for Academic VR Environments. The company provides VR equipment, CryEngine and its knowledge of how its used. Unfortunately, VR first did not respond to Özyeğin Universities application for collaboration.

In 2016, Bahçeşehir University established the first Academic VR lab in Turkey, ODTU and Hacettepe both followed in the year 2017. After research and careful examination, the OZU VR Lab has chosen to further its studies with the Unity Game Engine and stands as a 4th independent academic VR Lab among universities in Turkey.

Projects by the OZU VR Lab (vr.ozyegin.edu.tr)
1. OZU-X Innovation Center in VR
In Collaboration with the Basel University we have used the matterport camera brought from Switzerland to 3D scan a Commerce han in Karaköy and The OZU-X innovation center. These Environments can be explored in VR Glasses that hold mobile phones.
2. The Virtual Buddha Temple project: An immersive environment developed using the unity game engine. A photogrammetry project build by scanning a real temple environment in which contributors can explore and interact with objects.
3. The "Applying Activity Theory to Analyse a Virtual Reality Setting" paper:
A case study focused on applying Activity Theory to analyse an immersive environment designed to examine the mechanisms of user interaction design in virtual reality.
4. The New Faculty of Architecture and Design in VR: OZU VR Lab has successfully managed to render the new Architecture and Design faculty building being built. This way the new FAD building can be explored in Virtual Reality and visitors can have an idea how it will feel and look like.

VR as a teaching tool and its benefits
Up until here this paper mainly focused on how to teach Virtual Reality. However, to underline the importance of the technology's supportive qualities in education, the following section is set to describe the benefits of VR as a teaching tool. VR provides a notion of presence, thanks to this, the learning experience can be extended to a level of "learning a subject by living it" Considering the realistic practise VR presents, individuals actually conclude to existing in a special space. This notion employs the mind in a remarkable way. (Babich, 2018)

VR in Architectural education

Traditionally, the education of Architectural design is focused on sharing and discussing ideas between instructors and students. These ideas are communicated via plans, drawings and physical models. During educational discussions, it is difficult for contributors to modify the suggested models and to observe their interior spaces in real-time. As a solution to overcome these difficulties, VR proposes environments where multiple students can contribute to the manipulation of 3D models and explore design discussions within their internal spaces.

Figure 3. Architecture student constructing interior space with Sketchup in Virtual Reality.

By contributing to procedural modeling and the formations of rapid prototypes VR allows students and instructors to emphasize and improve theirs work much faster than traditional methods. For instance, the Fuzor app and certain plug-ins can instantly transform Sketchup and Revit models into immersive virtual reality experiences where adjustments can be applied smoothly.

VR in Industrial Design education

Along with Architecture, VR is also being used in Industrial design. Advanced VR applications support the design of 3D industrial objects in real-time spaces, improving the creativity of industrial design students and enabling them to understand, in a faster pace, how design procedures take place.

Figure 4. Industrial Design Students building a prototype with Gravity Sketch in Virtual Reality.

Overcoming prototype visualisation limitations through VR devices helps industrial design students make better design decisions.

VR in Communication Design education

VR is giving birth to an exclusively novel Arena of collaborative work, marketing, consumerism and especially education. User Experience (XD) scenarios require evolutionary approaches to accommodate these novel capabilities.

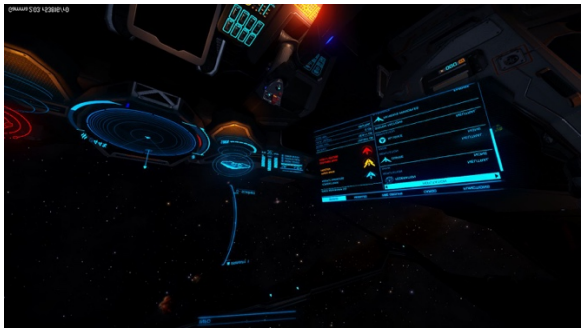

Figure 5. An Interface in Virtual Reality designed for navigational purposes to explore space.

Communication designers are responsible for building believable virtual environments taking account user friendly interactivity and important aspects like ease and comfort.

The Virtual reality and Immersive Design Course

In Mid 2018 with the support of our Communication Design department head Dr Simge Esin Orhun and Faculty of Architecture and Design Dean Prof Dr Orhan Hacıhasanoğlu, the OzU VR Lab was successfully settled. Accordingly, I was asked to form a course for the faculty covering the Virtual Reality topic in the Design context.

The VR and Immersive Design course to be thought in the Özyeğin University is planned to be structured as an elective for third year students. The course will contain multiple parts of VR practise and theory, involving hands-on experience to utilise a specific virtual reality environment.

With these means, an introductory, elective course in "VR and Immersive design" is proposed with the following priorities as learning outcomes;

- Apprehension of the VR discipline, in conjunction with its software and hardware.
- Grasp of the principles and design factors involving the creation of VR applications.
- Gain ground on practical experience by establishing Virtual Reality applications utilising VR environments.

- Utilisation of previous curriculum experiences for attaining the goals previously mentioned.

Sources, course material and recommended readings

Me and my colleague Elias Sarantopoulos have been researching Virtual Reality for almost 2 years. Besides the tools and software used, an essential part of teaching Virtual Reality is written books. After wide research on such sources we came along some good material. Many books have been published with respect to VR concentrating on technical and practical aspects. However, since VR technology is developing rapidly it is important to follow the most recent and comprehensive literature possible. Respectively, some academics have extensively researched the subject and have created broad and outstanding novel work. A great example is "Virtual Reality (2017)" authored by Steven M. LaValle, an American computer scientist, and professor in the department of computer science at the University of Illinois. LaValle's main field of expertise is

Robotics, even so, he started working as the head scientist for Oculus in 2012, the start-up which eventually got acquired by Facebook for $2 billion in 2014. Soon after this, LaValle returns to the University of Illinois carrying his new expertise with the educational mission of teaching the fundamentals of VR to a new generation of students. The book focuses on the recent specifics of VR technology with an aim to improve its readers understanding about how VR systems function, their limitations and which direction it is heading. This work can be used efficiently for an elective course by spending around one week per chapter to augment computer graphics, interfaces, and game development for Virtual Reality. In this light, it is planned to cover LaValle's Virtual Reality book during the VR and Immersive Design course.

Weekly Course Schedule

Reviewing the vast literature on teaching Virtual Reality, Hafner's (2013) and Miyata's (2015) methods look most promising. The following schedule is based on an overlapping composition of their work. The course is projected to consist of three parts and merges various curricular methods;

The first three weeks is premised on introducing VR through lectures and demonstrations. Brief presentations on issues like the history and definition of VR followed by Hardware and Software used for the medium, arranged for students to follow the rest of the course easily.

The next part (3rd and 4th week) is designed as lab sessions focusing on task-specific software like free 3D modelling software such as Blender and Google Sketchup, VR Game engines like Unity and Unreal Engine. Task assignments are applied to students who come from different disciplines.

The next nine weeks contain projects for groups via self selected tasks. Teamwork is an essential part of the course. The first two weeks are centered on group formations and assigning tasks to group members. Taking student interests in consideration, the supervisor carefully forms task specifications to meet the goals of the course. Additionally, every group has optional tasks. Subtask distributions are decided by the group members themselves internally. Once the assignment distributions are finalised the teams start to operate on their presentation goals. Inspired by both Hafner and Miyata, the weekly schedule can be found below; Weekly Course schedule is planned as follows:

1st week
Lectures and Demonstrations
2nd week
Lectures and Demonstrations
3D modelling
Task assignment
3rd week
Group formation
Lectures
Introduction to VR Software
4th week
VR Software
Group Project Plan Presentation
5-14th week
Project Group work
Soft Skills evaluation
15th week
Final evaluation

Figure 6. Weekly schedule for the VR and Immersive Design elective course

Why team work?

As mentioned before the course is in elective formation welcoming students from the selected department of Computer Science, Communication Design, Industrial Design and Architecture. A variety of skills are required to create VR applications. Beside development skills, design expertise like the foundation of spaces and objects and creating user-friendly environments is necessary as well. Teamwork based projects are a convenient way for establishing VR applications due to group members utilising previous expertise within the collaborative setting. Being actively involved in field work and groups discussions has a positive

effect on students' learning process. Students' collaborative skills will also improve by the influence of such teamwork projects (Fullerton, 2008).

The formation of teams

The following projections are made for the Grouping and the distribution of assignments to team members. Only one VR compatible computer and one VR headset exist. These will have to be used taking turns during the VR application development. This is why it is best to keep the amount of students around 12. The elective course is planned to allow 3 students from each department if possible. Team formations and distribution of assignments for each team member is planned as follows;

communication design student
~ Interaction Design
architecture student
~ Space Design
industrial design student
~ Object design
computer science student
~ Programming

Conclusion

As VR hardware becomes more affordable, the consumer VR industry is growing rapidly. Once an exotic field of Science now has become an important field for creative designers and programmers. This has his own effects on the education system making it a need to teach the new technology and its utilities.

In this paper it is emphasised why VR is an interdisciplinary field and how it should be learned in an interdisciplinary group environment. A vast amount of literature which argues on teaching Virtual Reality in team formations and by interdisciplinary means is put forward. The most related departments in the university are listed and it is explained how students from these areas can collaborate best. It is discussed how important it is to assign tasks when creating teams according to disciplinary backgrounds. Also, the importance of the game industry and the free software platforms they share are mentioned. The importance of the technology's supportive qualities in education are underlined in Virtual teaching environments. Alongside, course materials and novel sources by experienced teachers are proposed for weekly readings. Finally, a schedule for maximum collaboration for the elective VR and Immersive Design course is projected for best outcomes.

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Terms and Concepts on Design Studio in the Research Articles of 2010's

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Refer: Toprak, İ, Hacihasanoglu, O., (2019), Terms and Concepts on Design Studio in the Reseacrh Articles of 2010's, Journal of Design Studio, V.1, N.2, pp 13-22,

Abstract: Studio approaches change over time due to changes in the areas and concepts associated with design studio. What is the direction of this change and which areas came to the forefront? The theoretic base of this article gives a short history of design in different fields and also changes in the understanding and the approaches in design studio throughout history. In this article, first we define basic approaches realized in the last century. Then, we seek to investigate the concepts and topics around design studio term analyzing all articles that mentioned "design studio" and "design education" in the title and keywords in the last decade. For this purpose, we listed around 500 words and concepts in 262 SCOPUS indexed journal articles published between 2008-2018 and found the most repetitive words. We determined their proportions within the total and investigated their connections and networks. By using network analysis, we tried to construct focus areas, relations and connections between words terms and concepts related to the recent approaches in the design studio field. The terms and concepts also ranked according to years-based changes. We found that some concepts are becoming more popular or less popular in yearly based ranking of terms and concepts. The research findings of the article show that design studio education had trends on being more locally identical, more systematic, interdisciplinary, process oriented.

Keywords: Network Analysis, design studio, article, last decade

Introduction:

The design studios accepted as the backbone of the curriculum in many design education programs at university level, like architecture, interior architecture, landscape design, urban planning, urban design and in all type of design disciplines. Design studio by definition is a space where design processes are realized. Design studio, in any type of education, occurs as a type of course in which design education by practicing to work on some design problems or some environment or media starting from simple problems and ending with a very complex one to give ability of designing environment, building, space, product, system, interaction, graphic, media, communication, and related activities. Design studio courses generally based on design problem solving or working on a special place to find correct improvement on design issues of that special environment. These are sometimes may be one long term assignment, sometimes multiple problems given in the design studio. Design education in design studio considered as an organism which has a culture which should be established and defined by the stakeholders like students, instructors, related sector representatives, administrative people of schools. Architectural design studio culture is considered as an important part of educational philosophy of schools of architecture starting from late 1990's in USA (Hacihasanoglu, 2019). The starting point of design studio may be considered as *Ecole de Beaux-Arts* (Drexler, 1984). Before design studio education the educational system of many design disciplines including architecture was organized in guild organization as a part of master-apprentice relations-based education.

The nature of the contemporary design studio is consistent with the model of teaching exemplified by Plato, who encouraged the free, independent exchange of knowledge and

information. He brought disparate thinking into a forum of discussion, much like that experienced in a modern-day studio. His model of teaching became known as Platonism and his community of scholars referred to as Academy (Pevsner, 1940). In Italy, during the latter part of the 15 Century, a large number of schools flourished based on humanistic discourse; a free, sociable and informal means of discussion so vastly different in nature to the scholastic pedantry of the universities of that time. These schools later came to be known as *Academia Platonism* (Green, Bonollo, 2003).

The first implementation of the design studio in architectural education came from 1819 when the classical atelier system of the French Royal Architectural Academy transformed into *École des Beaux- Arts. Academie des Beaux-Arts*, founded in 1648, as it developed it played a most consequential role in European architecture. The *atelier* system in the *Beaux-Arts* program not only aimed to improve "artistic" but also "analytical and structural thinking skills" of the students (Drexler, 1984). At the *Ecole des Beaux Arts* a student was admitted to the atelier of one master, and stayed there throughout his or her education (Goldschmidt et al., 2010). Undoubtedly compared to the traditional teaching methods, the framework that contemporary design studios of architectural schools present worldwide is a very different one. The curricular structure of the *Beaux-Arts* School was twofold: practical and formal, in which the design studio was not central but lateral. The practical education was more like a craft training in which the students were learning to work with different materials such as stone, timber, metal, clay and glass. The formal education concentrated on the problems of architectural form through observation, representation and composition, and introduced the theories on space, color and design (Balamir, 1985). In this two sections structure, particular knowledge was gained by means of certain skills, i.e. learning materials by giving form to them, learning geometry, color, space and structure by drawing, painting and model making.

Currently the student comes across at least 8-10 studio tutors during their academic program (Ciravoglu, 2014). Design studio and atelier of design and art education had been continued in the following years in different schools like Bauhaus, Mackintosh School and others. Since the Mackintosh School was founded in 1845 as one of the first Government Schools of Design, as a center of creativity promoting good design for the manufacturing industries, its role has continually evolved and redefined to reflect the needs of the communities, embracing in the late 19th century fine art and architecture education and today. Mackintosh was one of the most influential designer-architects of his generation. Born in Glasgow in 1868, he was central to the development of a unique *Glasgow style* in the arts; a style that was to be Scotland's response to the art nouveau movement. However, with his design for the Glasgow School of Art, in particular, he is also rightly revered as one of the early pioneers of modern design of the 20th century.

The Weimar Bauhaus School, established by Walter Gropius in 1918, based on an educational style of "architectonic approach" to architectural education covering various branches of art and design within a vast perspective. "Focusing on three-dimensional perception in comparison to the two-dimensional compositional approach of the Academy, the Bauhaus School differed from *École des Beaux-Arts* by providing the students with an ability to unfold their creativity, imagination and personal expression" (Balamir, 1985). Gropius introduced the philosophy of the Bauhaus in 1919 by manifesting that "there is a close relation among all disciplines of arts and craft" (Benton et. al., 1975). The curricular structure of the Weimar Bauhaus School consisted of three periods:

> "*Introductory Course introducing knowledge on form and composition, the General Course introducing knowledge on space and surface design as well as construction, and the Architectural Course focusing on steel and reinforced concrete buildings. While the basic knowledge on form, composition and color were introduced by means of analytical drawing, painting, observation and bodily performance during the Introductory Course, the advanced theoretical knowledge on space, material, function, economy and aesthetics were taught in*

various theoretical and technical courses and the design studio in the Architectural Course" (Salama, 1995).

The Bauhaus education may be considered as the basis of a design studio-centered education, in which the theory and the practice of architecture were integrated within an inter-disciplinary environment. Compared to the two-sectioned formal and practical structure of *École des Beaux-Arts*, practical studies in material workshops of the Weimar Bauhaus School were closely integrated with theoretical studies of color, composition, construction and nature, especially in the last three years of education. Between 1930 and 1960, schools of architecture in various countries followed two different approaches: the two-sectioned formal-practical structure of *École des Beaux-Arts* in which *ateliers* were separated from theoretical courses and the three-staged Bauhaus system in which practical and theoretical studies were integrated in *ateliers*. The architectural education in the US had been under the dominance of *École des Beaux-Arts* until the foundation of the New Bauhaus School by Sibyl Moholy-Nagy in Chicago in 1936. As each student in the Chicago Bauhaus was required to take a two-year introductory education including basic design, analytical and structural drawing, model making and basic scientific knowledge, the integration of architectural theory and practice in the design studio seems to have started in an earlier stage than it did at Weimar Bauhaus.

Similar approaches were seen in other countries like Turkey. As a new system, the student has the right to work with different instructors in each project by selecting the workshop group that s/he wishes without depending on a workshop and the same teacher. The workshops that transformed into a professional competition environment with the new system, allowed the exchange of ideas between the larger working groups (Toprak, Hacihasanoğlu, 2019). Beginning in the early 1990s, with the development of personal computers in the mid-1990s, design studios began to tend to more computer-aided design oriented and increasingly moved away from the academy education of master-apprentice relationship. With the effects of the design methodology that began to settle in the 1960s, instead of learning from the masters as in the academy education in the studio approaches of *Ecole de Beaux Arts*, the structuring of the process and the defined methodologies, approaches and focusing solely on the master instructor began to develop in the design studios. These approaches have also been addressed by researchers in design science. Donald Schön has often argued that the professional education of architectural students – and other design students – should be aimed at making them into 'reflective practitioners' [Schön, 1984]. Design is focused on subjective creativity, but the positivist university paradigm is focused on objective rationality. In order for design education to become more rigorous – and more academically respectable – it must either become more rational or it must embrace a new paradigm that values creative experience.

In the USA, industrial-design education formally started at Carnegie Technical College (later to become Carnegie-Mellon University) in 1935-1936, under the direction of Don Dohner. This was followed by the Pratt Institute of Art in New York and these developments, together with those occurring in industry, served to establish the industrial design profession. Design education in this period grew from the demand for mass- produced products and the vision of design educators to delineate industrial design apart from architecture and engineering (Kaufman, 1999).

Figure 1. demonstrates us the timeline of different design studio trends and approaches other way of saying *ecoles* of different design studio implementations. It is started from 1930s with beaux-arts school of architecture which had two-fold structure, learning architectural design in atelier and learning different materials by working on these materials and the practicing materials supported by theoretical courses. Bauhaus school based of the educational approach of relations between arts and crafts. Therefore, design studio interacted with this idea of accepting arts and crafts interaction. Approaches of Bauhaus school starting from 1930s and affective in current design education partly. Process-oriented design approaches which had implementations of case problem model, analogical model and interactional model appear 1960s in design studio. Design research and research by design methods have been affective starting from 1960s and have been continued in

contemporary design studio approaches. After personal computers widely used in 1990s

computational design approaches, and related issues like virtual design studio, collaborative solutions in design and some experimental design approaches have been implemented in the design studio. After sustainability became very affective in all scientific areas, integrated design had been entered the design studio studies after 2000.

role in architectural education. Donald Schön defines architectural design a particular kind of inquiry, "a making of representations of buildings to be built". This inquiry, he suggests, is "one derived from reflection on spontaneous knowing-in-action implicit in architecture making" (Schön, 1984). Therefore, he considers the architectural design process a "reflective practicum" in which disciplinary knowledge is produced through "reflection-in-action" in the design studio.

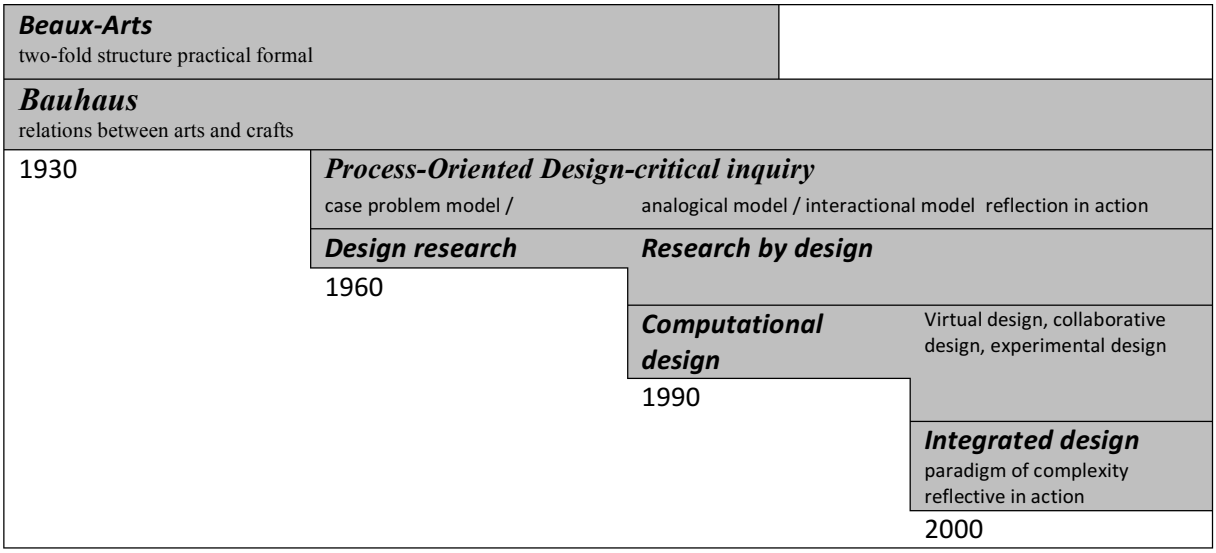


Figure 1. Design studio history timeline.

"Despite the emergence of alternative studio teaching models such as the case problem model, the analogical model, the interactional model, etc. in the 1960s, as well as the Critical Inquiry and Process-Oriented Design Pedagogy in the 1990s, the current approaches to teaching architectural design continues to follow principles, rules, and practices developed under the influence of the traditional *Beaux-Arts* and Bauhaus models" (Salama, 2015). Design studio education in many schools of architecture around the world is characterized at two extreme poles, either abstracted from problems of the real built environment or directed towards the expectations of the construction sector, both of which reflect themselves in the acquisition of various knowledge and skills required from the students of architecture in traditional or critical models of education.

Contemporary scholars of architectural education approach the design studio from different theoretical and methodological perspectives, yet mostly defending its central

After Schön's approach, it is suggested that the emerging "paradigm of complexity" for design studio education derived from complexity theory. Considering the design studio "the norm or status quo for design education practice", Wang proposes a paradigm shift "replacing positivist theory with complexity theory, rethinking the epistemology of design, becoming more aware of the systematic processes of design, and integrating multidisciplinary approaches to design projects and activities (Wang, 2010). Some design studio instructors had the idea of reorientation of architectural design education toward an engaging policy that considers the social responsibility of architects. This idea followed by "an integrated design paradigm" in which rational problem solving and reflective-in-action are integrated within the design process (Bashier, 2014).

Some researchers make comments on the role of the studio by providing emphasis on knowledge production regarding various areas of the built environment. The current culture of

architectural education "socializes its members through high emphasis on form and abstract aesthetics while superficially adopting fragmented pieces of knowledge on technology, ecology, social sciences, sociopolitical and socioeconomic aspects" and that the impact of this culture on students could be observed in their lack of communication with public, testing hypothetical solutions during design process as well as knowledge on technology, environment and users (Salama, 1995). To overcome this problem, he suggested a trans-disciplinary approach to architectural education, integrating three types of knowledge production: disciplinary, cognitive- philosophical and inquiry-epistemic (Salama, 2007, 2015). Some other researchers emphasized the lack of communication between stakeholders and teamwork skills in the design studio, which prevent the students from engaging with a changing society and developing a sense of community (Nicol and Pilling, 2000). It is proposed that a comprehensive approach that establishes an epistemological base for architectural education by means of research and a skill-based curriculum for schools of architecture, in which multi-disciplinary knowledge on architecture could be gained by means of intellectual, communication and social skills Richard Foqué (2011). He considers research by design "an essential cornerstone as it conceives possible realities, investigates their desirability, changes the existing reality by implementing a new one. Research by Design / Design Research: Bayazıt (2004), associating Design Research with design methods, started the first-generation design methods in 1962 with Morris Asimow's "Introduction to Design". Christopher Alexander's doctoral dissertation "Notes on the Synthesis of Form", Chermayeff and Alexander's "Community and Privacy" is listed. H. A. Simon's first conference in the USA, The Sciences of the Artificial, he and his colleagues presented artificial intelligence (Al) at Carnegie Mellon University. Second generation design methods Simon is said to start with the above-mentioned book (Bayazit, 2004). The first-generation design methods were formulated and applied by scientists and designers. The objectives of the design problem also were identified by them during the design process, which caused rigidity in design decisions and unexpected failures. These simplistic methods were necessary at the beginning. Horst Rittel proposed new argumentative methods as "second- generation design methods." His methods, argumentative method, and IBIS (Issue Based Information System) were problem identification methods, which were influenced by the British philosopher Karl Popper. These second-generation design methods began to compensate for the inadequacy of the first-generation design methods

Computational Design: Some design and architecture schools still use manual techniques similar to those used at the beginning of the last century. For a long time, design studio activities were carried out using manual sketches, drawings and physical modeling. Since the late 1980s, architecture and architecture education has witnessed a significant transformation with the introduction of computers and information and communication technology (ICT), which have become widespread in all areas of practice and education. Many schools have increased IT content in their curricula and are investing in computing resources to enable their students to provide the necessary skills and competitive advantage. Modern information and communication technology and digital tools have been adapted to architectural education and practice since the 1990s. Computer Aided Design (CAD) has been adapted to architecture and has become the main working environment. CAD and digital media have also been adapted by many architectural schools around the world. The rapid developments in information and communication technology and its applications in architecture have created a new opportunity for studio teaching.

Integrated Design: Design Studio courses represent a studio-based training system in which subjects are handled in a process-oriented approach. Current technologies give more opportunities to integrate the processes of different works in different disciplines. Integrated architectural design process approach is one of the case for this integration in planning, design, construction phases of architecture and its stakeholder disciplines. Integrated Design Process (IDP) was used in the early 1990s, by Canada's C-2000 program and IDEAS Challenge competition to describe a more holistic approach to building design. This

design process has been shown to produce more significant results than did investment in capital equipment. There is now no single "right" definition for IDP. Rather, IDP describes a different, intentional way of approaching sustainable building and community design that offers a much higher likelihood of success than any other approach (Zimmermann, 2006).

All these different approaches in design studio follow some basic concepts and terms in their active periods. The basic aim of the article to find to active terms and concepts of last decade in design studio by searching keywords, terms and concepts in the titles and text of scientific research articles published in the journals indexed in SCOPUS. We explain the materials used in the research and the methodology followed in searching the materials and the findings of the research are in the following part of the article.

Methods and Datasets

This article seeks to discover how design education evolved in the last ten years. It aims to investigate the concepts and topics according to titles and keywords of the articles that mentioned "design education" and "design studio" in the last decade. For this purpose, we listed around 500 words and concepts in 262 articles in SCOPUS archive. We derived recurring keywords from the author keywords section, we determined their proportions within the total and in a yearly-based comparison chart. Finally, we investigated their connections and networks according to their meanings.

The most repetitive words are arranged according to the frequency of repetition. With this method, we reveal the most used words and concepts in the research published in the last 10 years.

Figure 2. shows us most repeated terms and concepts: design education, design studio, creativity, architectural design education, architecture and collaboration are the most repeated words. The following keywords include many important keywords such as; design process, sustainability, design thinking, assessment, experiential learning which are seen as the valuable concepts for design studio approaches and applications. The second group also includes the professional backgrounds such as: architecture, architectural design, interior design, industrial design and urban design. The following third group of terms and concepts include collaborative design, design pedagogy, virtual design studio, blended learning, design methods, design research, design studios, feedback, problem-based learning, reflection, studio, virtual reality, action research and adaptive reuse. The fourth group of words and concepts consist of ethics, learning spaces, studio teaching, studio-based learning, basic design, co-design, context, critique and many others.

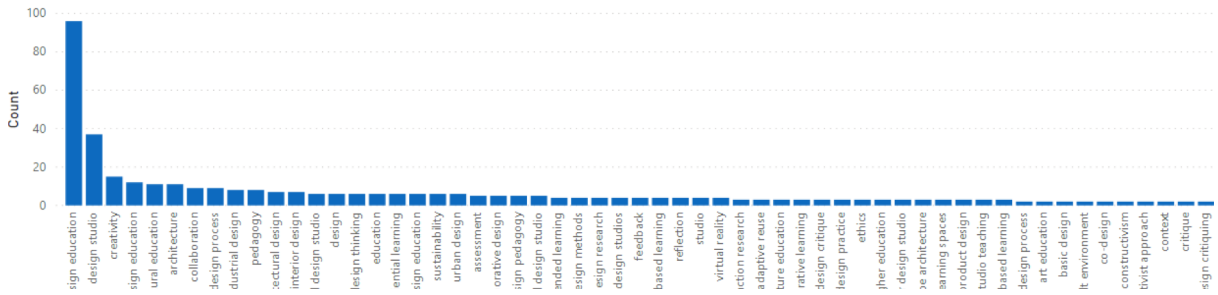


Figure 2. Most repeated words and concepts in the 'design education' articles between 2009-2019

It is also important to see how the importance given to these keywords develop over the years. Therefore, we also assessed the repetition of concepts and keywords on each year. This investigation allows us to find out the popular terms in yearly basis. In this way, we determine

the words and concepts according to their priorities in different years, and it is also possible to track their popularity rise and decline.

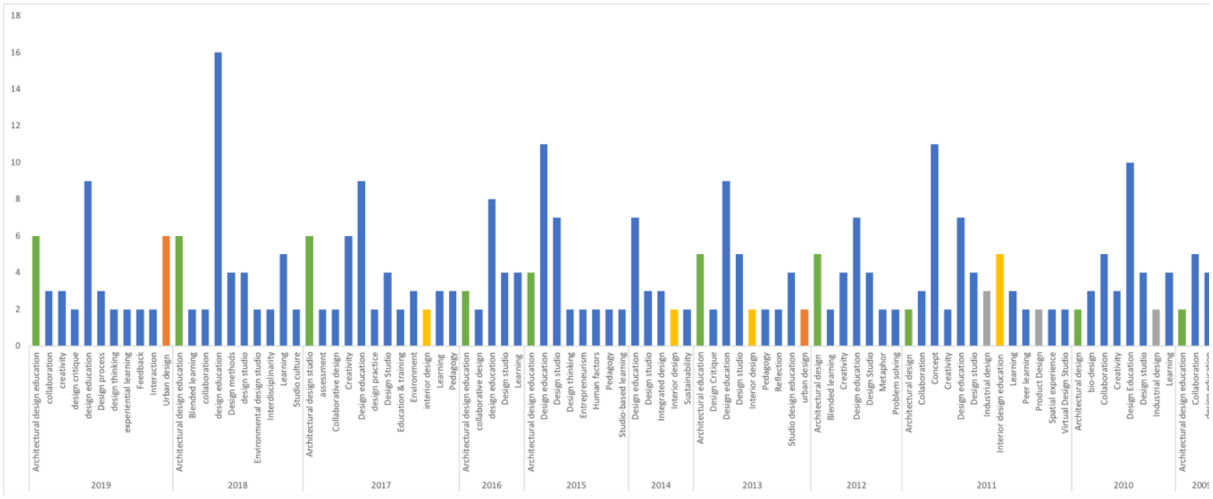


Figure 3. Most repeated words and concepts according to years.

Figure 3. shows how the keywords evolve through the last ten years in general. The most repeated concepts are design education, design studio, architectural (design) education, creativity and collaboration. These concepts are consistent throughout the decade. Some keywords have reached a peak at the year that they were used by many researchers: in 2010, 2015, 2018 and 2019 "design education" reaches a peak point. In 2011, "concept" is a very popular keyword.

Figure 4. describes how the design education keyword evolves during the decade. Because we used it as a keyword in the search engine, it appears as it is the most popular among the other keywords. It reaches a peak point in 2018, and it is consistently used during the decade. It seems that design education as a keyword is quite popular during the decade, but it is likely that research about design education is becoming more popular towards the end of the

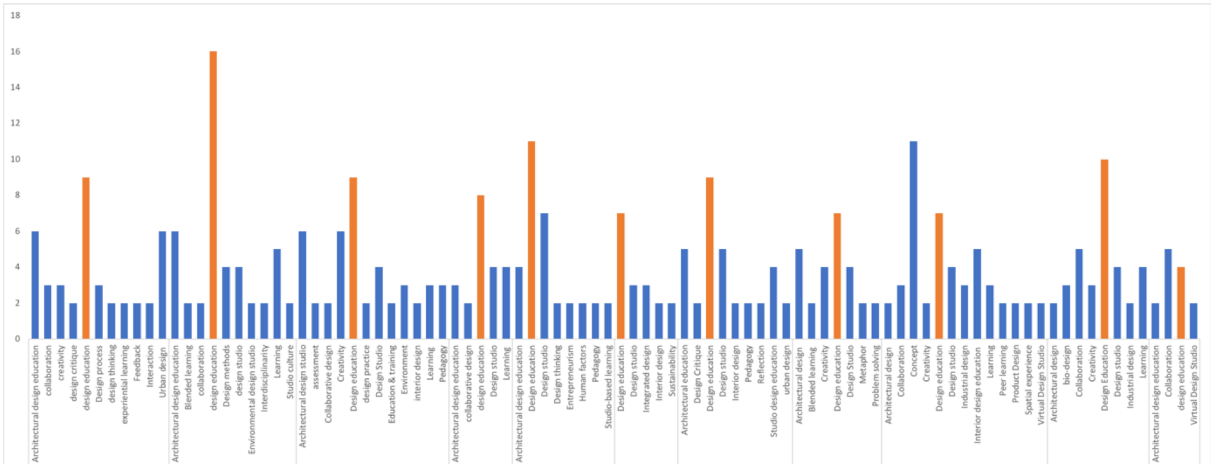
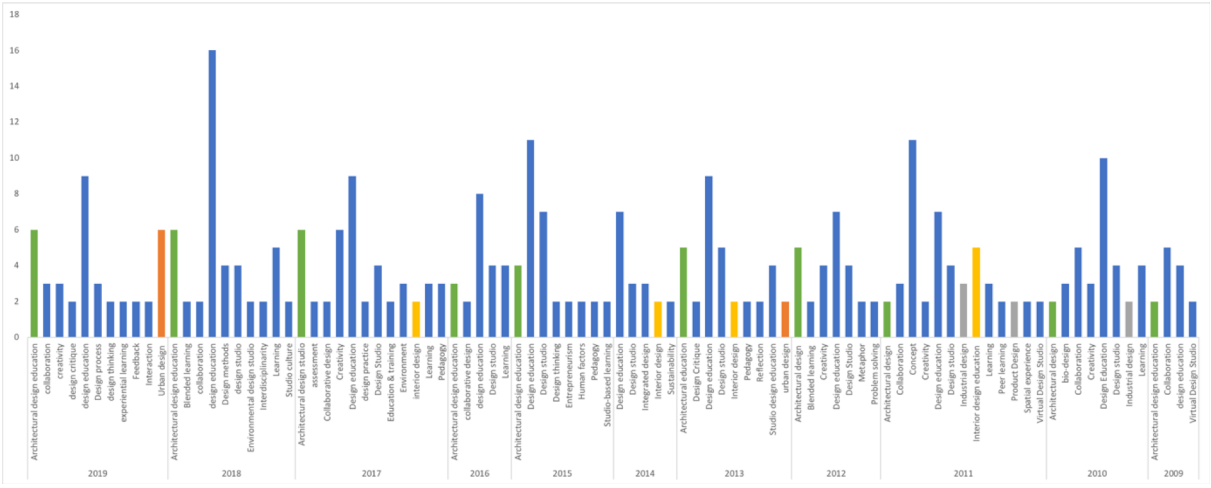


Figure 4. Design education keyword frequency according to years

decade.

Figure 5. Keyword frequency for different professional



education according to years.

Figure 5. tells us more about how design education research comes forward as part of different professional backgrounds. Architecture produces research about design education consistently through the decade with an increase towards the end of the decade. Urban design becomes more popular in the design education articles towards the end of the decade, but it does not remain consistent throughout the decade. Interior design has a quite consistent contribution to design education research but there is a slight decrease in the trends towards the end of the decade. Industrial design and product design has only been popular in 2011, other contributions of the profession group are not consistent throughout the decade.

Figure 6. shows popular concepts according to years. The keyword "concept" reaches the peak in 2011 and it remains the only year that this term is mentioned. There are more consistent terms that stay popular throughout the decade: these are "collaboration/collaborative design" and "creativity". This fact describes the importance of collaboration in design education in the last years, as well as creativity remains as a popular concept in design education. We also can follow the emergence of some learning concepts like blended learning experiential learning, peer learning, studio-based learning. The most recent one of these learning concepts is blended learning.

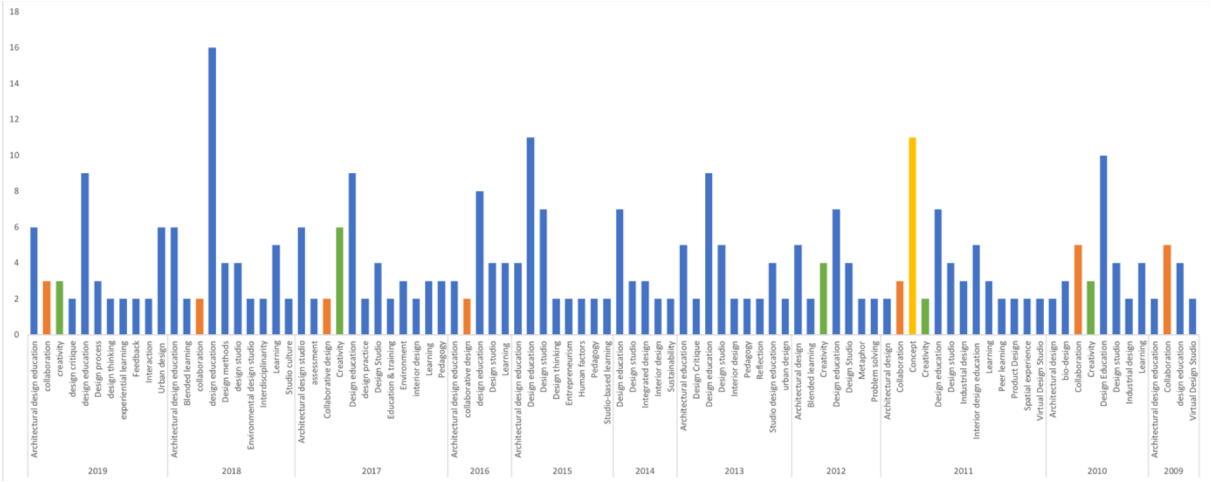


Figure 6. Some popular keyword frequency according to years.

We try to reveal the hierarchy and fictional structure of the relationships between words and concepts by network analysis. We aim to establish connections between the most repetitive words by linking them in terms of meaning by network analysis.

https://graphcommons.com/graphs/2ca4be9b-2170-404b-a31a-d09208a1458d

Figure 7. Network Analysis of the most repeated words and concepts.

In the network analysis the main interaction between design and the main disciplines like architecture, architectural design, interior design, industrial design, graphic design, communication design and urban design. Creativity concept in design studio appears in the network analysis as interactions between creativity, design thinking, design process, creative processes, reflection and reflective practices. Interaction between design education and pedagogy extended in the network with the concepts of learning, experiential learning, distance learning, collaborative learning and blended learning. Collaborative learning and experiential learning are in relation with collaboration, interaction and participatory design concepts. The other mainstream in the connection of the network interaction between design, sustainability and environmental sustainability. All these relations and interactions are demonstrated in the Figure 7.

Conclusion:

All the design education approaches over the last century lead to a continuous will for the research of design education. However, the design education articles written in the last decade show us that the major keywords and concepts are evolving and changing. The most used keywords and concepts, apart from design education and design studio which were the search keywords of this dataset, notably creativity, collaboration, learning/pedagogy concepts show that there is a constant inclination towards new ways of learning such as blended learning, peer learning, studio-based learning, collaborative learning and experiential learning, and the search for creativity in design

education as many related concepts such as design thinking, design process, creative processes, reflection appear in the articles.

The evaluation of the terms and concepts according to years put forward that there are consistent terms that stay popular like "collaboration/collaborative design" and "creativity". There are also terms that become more popular towards the end of the decade such as urban design and architectural design education, meaning that more research has been done in those disciplines. There are also a few concepts that have been more popular in the beginning of the decade but started to become less popular towards the end of the decade like virtual design studio.

The research findings of this article show that design education had trends on being more locally identical, more systematic, interdisciplinary, integrated and process oriented. Studio education remains as one of the most crucial ways of teaching design, and the last decade allows many different integrated ways of learning, including interactive, collaborative and experiential methods.

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