

TEACHING DESIGN FROM A DISTANCE: A CASE STUDY OF VIRTUAL DESIGN STUDIO TEACHING VIA A SOCIAL NETWORK

P. Fotaris¹, I. Mavrommati², R. Leinfellner³, T. Mastoras⁴

^{1, 3} *University of East London (UNITED KINGDOM)*

² *Hellenic Open University (GREECE)*

⁴ *University of Macedonia (GREECE)*

Abstract

Design Studio teaching has been an established method in art and design academia for over 80 years. In design studio, theoretical knowledge and practical skills mix. The design process is taught by living through it, thus accessing deeper levels of cognitive, technical, and social skills. Studio facilitates experimentation, exploration, and synthesis, along with team working and peer-learning. Virtual Design Studio (VDS) addresses the same needs in online design education, but has three significant differences: geographically distributed participants; teaching and learning via digital objects; and asynchronous or/and synchronous communication. Asynchronous increases schedule flexibility, but written communication is more time-consuming than discussion. Additionally, the large amount of data to be processed and the required feedback increases one's workload. VDS feedback is not immediate and is limited to only uploaded designs, thus affecting subsequent developments of student drafts. Since interaction between participants depends on practical and psychological constraints and ICT skills, it may not be as focused, rich or immediate as in the traditional studio. Although several VDS solutions have emerged in the past two decades, yet there is no single established design-teaching model that replicates the design studio method. Nevertheless, most current ICT technologies, including social media, share several common core features: emphasis on cooperation, reliance on a common set of tools, merge of synchronous and asynchronous communication, easy remote access etc. As people's skills are constantly evolving in the use of digital tools and social media, the integration of the latter into VDS gradually moves design tutors from teaching and makes them facilitators of learning, while all participants become stakeholders of classroom interaction. The current paper explores the aforementioned notion through the use of the deviantArt (dA) platform (a dynamic online studio) in a design teaching method. The study reports on experiences from a distance learning MA course in Graphic Design, with 50 mature distant students per year. At the end of each of 3 consequent academic years, an evaluation was carried out so as to assess its validity as a distance teaching method for design and identify its weaknesses, strengths and improvement opportunities. dA displayed visuals without the navigation overload of online collaborative virtual environments. Each year 5 main assignments were created and more than 700 images were posted, with more than 6000 page views. Feedback from peers and tutors was seen as an important part of the design studio process, however due to several factors, it was not practiced in full extent. The opportunity to have an overview of design portfolios and to compare one's work with another's was favoured. This practice was particularly beneficial for weaker students and those without an art/design background, as it improved their understanding of assignment requirements, and made them aware of quality and assessment criteria. Since teaching design to a multi-disciplinary group of distant learners is a challenge marked by the lack of an established physical community and by limited opportunities for face-to-face tuition, the paper discusses how the use of social media as a VDS teaching method encouraged a sense of community and provided an overview of the work of peers, and therefore enabled creative stimuli and peer-review comments.

Keywords: Virtual design studio, social networks, technology enhanced learning, peer learning.

1 INTRODUCTION

The design studio format has been the dominant method of design education for Fine and Applied Arts, Architecture, and Industrial Design since the 1940s [1, 2]. In its current form, it largely adopts the pedagogical principles of the Bauhaus School, which, in turn, were based on previous training methods initiated by the medieval guilds and evolved through various movements (e.g., Arts and Crafts) during the 19th century. The design studio differs from the typical classroom by being primarily a space for production, personal discussions, and experimentation with materials and tools, which takes place in a setting replete with drawing boards, workbenches, stools, papers, images, models,

as well as other teaching aids [3]. In this setting, students develop sensitivities to a number of fundamental yet volatile elements of design education such as problem-based learning, teamwork, sensitivity to market opportunities, and the ability to generate innovation while they create, exhibit and discuss their work with their peers [4]. The emphasis on this kind of communication and cooperation constitutes the main feature that distinguishes this particular environment from that of a classroom or lecture theatre.

A similar philosophy is followed by the Virtual Design Studio (VDS), a form of virtual workshop that addresses the needs of online design education. Although several VDS solutions have emerged in the past two decades [5], there is currently no single established virtual teaching model that replicates the design studio method in a digital context, and the Internet and Communication Technologies (ICT) involved (as well as the students' ability to use them) are currently undergoing a period of rapid development and change. One can, nevertheless, identify a number of core features common to all extant solutions: an emphasis on cooperation, the reliance on a common set of tools, an ability to mesh synchronous and asynchronous communication, the availability of easy remote access, the existence of a central data repository, and the need for a specific technological infrastructure [6]. Social interaction through the design interaction, which is important to the learning and engagement with the design, is enabled through chat windows, blogs, emails, wikis and other online communication tools. However, existing VDS solutions do not recognize social engagement as crucial or central to the overall process of construction of knowledge [7].

This is something that can change though if Social Networks (SN) are infused into the learning environment as a methodological resource to make the teaching and learning process more dynamic. These technologies have the potential to transfer communication, democratic interaction, teamwork, social engagement, leadership, and responsibility away from the design tutors to the students, thus turning problem-based learning in a VDS into an iterative and reflexive process which facilitates deep learning [8]. The connections formed on SN *"provide a context for the implementation of Connectivism"* which *"explains learning in terms of interactions on a network where the learners exchange their knowledge"* [9]. Based on that notion, SN are important for maintaining connections among people in different areas while constructing or updating knowledge [10].

This paper presents a comparative study of the traditional and Virtual Design Studio methods in an effort to identify their principles, characteristics, strengths and weaknesses, and the pedagogical implications of the latter in distance learning. It also describes the use of deviantArt, the world's largest online art gallery and community [11], as a delivery platform for a postgraduate distance-learning course in Graphic Design and discusses its impact on enhancing the learning experience and motivating design students to collaborate and communicate design proposals.

2 BACKGROUND

2.1 Design studio pedagogy

The design studio method builds on the interaction between the internal knowledge of the student and the learning material [12], and avoids distinguishing between theoretical knowledge and practical skills. Students learn the design process by experiencing it while tutors monitor their progress and make observations, which guide analysis, development, and production. Since there is no rigid teaching methodology, the design studio can be seen as *"inherently dynamic, a convergence of spontaneous action and knowledge, and adaptation to changing situations"* [13]. Its teaching methods are grounded in a constructivist view of human perception and thought-processes [14, 2, 15] and in sociocultural theory [16], which argues that learning is not an individual function of human cognition but involves a process of participation in communities of practice or learning [17], either real or virtual [18]. According to this view, knowledge is determined by the context in which it is realized; the theory postulates that the knowledge of the community is more extensive than that of the individual, and that every community member can contribute to the cognitive development of the group [19].

Within the studio environment, students hone technical and social skills, understand the mechanisms of learning, attain cognitive benefits, and gain knowledge through experiences related to their design assignments [20, 21, 22]. They explore ideas and concepts at each stage of the design process and validate them through active participation in classroom discussions in which each student contributes his/her personal experience, outlook, insight, knowledge, and skills in order to address specific issues, propose solutions, and enhance the learning achievements of the rest of the group [23]. Consequently, the design studio method can be described as a process of collaborative peer learning

that promotes experimentation, exploration, discovery, constructive criticism, and artistic expression, and as a teaching method in which the tutor acts as a sponsor, counsellor and spiritual mentor [24, 2] who facilitates learning by discussing solutions and alternatives. In this context, the tutor's key role is to help students gain an in-depth understanding of each problem, identify and deploy appropriate techniques to address them, and develop the skills of reflection [25]. The latter can be summarized as a combination of learning by doing, sharing experiences, seeking advice, and reviewing design proposals in order to select the optimum solution to the design problem.

The contemporary design studio format, as it is applied to Architecture and Fine Arts education, starts with the establishment of a design problem, and is focused on assessing potential solutions through regular reviews and discussions that involve both tutor and students. A typical class consists of 12-24 students who have between 4 and 12 contact hours per week. At the end of the academic year, a panel assesses the students' work; this assessment may be complemented by a public defence or an exhibition of the final designs [3, 26]. The ultimate goal of such a course is to learn by addressing a specific design problem set by the tutor as a design assignment (design brief) and by advancing through the phases of the design process from conceptualisation towards the final design proposals. This problem may be modelled closely after an actual project under consideration in the community and take into account any existing, political, sociocultural, organizational, economic and technical constraints, or it may be a hypothetical design project developed to explore specific aesthetic, functional and/or technical issues [27].

Once the design assignment has been set by the tutor, students enter a brainstorming stage in which they discuss the brief and exchange ideas; at this stage, the participants list as many characteristics of the given problem as possible in order to create a chain of associations that will eventually provide the background to their proposed solutions. Throughout the course of their work, students present their solutions to both their tutor and their peers in order to receive feedback; occasionally, external examiners may also be involved [26, 28]. Peer review is particularly important because it encourages social interaction among students and enhances their ability to engage in collaborative problem solving and teamwork [15]. For this reason, it is important to have an appropriate setting in the studio space (e.g., display areas) for showcasing student work [26], since studying the work of others can serve as an inspiration and therefore lead to approaching the design problem from different angles [29].

The traditional design studio format includes at least four distinct and formal phases of critique: desk critique or desk crit (the tutor or students commenting on the work being designed on an individual basis); pin-up (in which designs are displayed to the group for peer-review); interim or midterm crit (an interim stage involving a more formal presentation); and final crit (final presentation to a panel of experts) [26]. The strengths and weaknesses of the design studio format are summarised in Table 1.

Table 1: Strengths and weaknesses of the design studio teaching method.

Strengths	Weaknesses
<ul style="list-style-type: none"> • Stimulates creativity by showcasing students' works • Allows continuous monitoring of students' progress • Is focused on real-world design problems • Promotes innovative solutions • Acts as a platform for feedback and debate • Facilitates peer-group interaction • Fosters a competitive spirit conducive to creativity • Allows instant evaluation of progress • Facilitates contacts with established practitioners • Promotes creativity • Encourages self-reflection 	<ul style="list-style-type: none"> • May encourage the pursuit of ambitious solutions over feasible ones • May engender feelings of alienation or self-centredness • May encourage excessive self-expression and thus hamper problem solving • May encourage an over-reliance on the tutor • Is easily undermined by participants' unwillingness to engage with feedback • Is easily undermined by participants' unwillingness to contribute solutions • May produce antagonism among students • Leaves student work vulnerable to exploitation by other participants

2.2 The Virtual Design Studio

The teaching methodology of the VDS is similar to that of the traditional design studio; there are however, three significant differences [12]: participants are geographically distributed; the teaching and learning occur in a virtual environment and involve the creation and manipulation of digital objects; and the communication between participants can be either asynchronous or synchronous. The stages of the design process itself match those of the traditional studio method, and are as follows:

a) analysis of the problem and subsequent research, b) development of ideas, c) revision of ideas, d) presentation and evaluation.

Initially, the students generate ideas that address the problem encapsulated in the design brief and propose solutions, usually by using software to create digital drafts. However, the process of developing digital drafts is more time-consuming than producing hand-drawn sketches. As a result, the time constraints associated with using software to create sketches in the very early stages of the design process results in a brainstorming stage that is less intense and may generate more superficial or less numerous solutions than its traditional counterpart [30]. The next stage of the process involves the virtual exchange of ideas, opinions and feedback within the peer group, and requires access to broadband Internet connections. Subsequently, students share their ideas with the tutors and refine their proposals incrementally with the help of the feedback they receive. The submission of the finished product is often followed by a final crit, similar to that of the traditional design studio [26], but delivered electronically – either asynchronously or in real time.

One of the main advantages of asynchronous communication for tutors is that it increases the flexibility of their work schedule. However, as the size of virtual classes tends to be larger than that of the physical ones and written communication tends to be more time-consuming than its oral counterpart, the large amount of data they are required to process and the amount of feedback they must generate increase their workload [31]. In addition, the geographically distributed nature of the VDS does not allow tutors to see the versions rejected by the students at any stage of the process; this limits the amount of feedback they can provide. A further issue to consider is the manner in which a reliance on asynchronous communication may affect students: since feedback from both tutors and peers may no longer be immediate, the development of subsequent drafts may stall or temporarily continue in the absence of feedback [32]. This issue may be compounded by a reduced overall engagement with the peer group due to a lack of time, a lack of incentives or a lack of motivation.

Nevertheless, the remote evaluation of design proposals remains an attractive option, as it has the advantage of allowing location-independent participation. However, unlike members of traditional design studio panels, assessors of online portfolios do not always have the opportunity to see the student's complete portfolio at a glance. In a virtual setting, the designs are usually examined in sequence and cannot be easily cross-referenced. Additionally, in contrast to the large format, high-resolution images displayed in a traditional setting, digital images are often small and feature relatively low levels of detail [6]. Furthermore, the non-structured dialogue encountered during the evaluation stage in the traditional studio process is rarely replicated online due to technical limitations and reduced interest from the panel [32]. A structured overview of the strengths and weaknesses of the VDS can be seen in Table 2.

Table 2: Strengths and weaknesses of Virtual Design Studio.

Strengths	Weaknesses
<ul style="list-style-type: none"> • Allows time- and location- independent communication • Accommodates larger class sizes • Supports one-to-one, one-to-many, and many-to-many communication • Prioritizes group work • Encourages the development of advanced IT skills • Allows for wider participation of practitioners • Facilitates continuous access to learning material in a wide variety of formats • Allows for a more flexible work schedule • Enables students to reach a wider audience • Facilitates cross-cultural collaboration • Facilitates contacts with established practitioners 	<ul style="list-style-type: none"> • May be undermined by the potential unreliability of online sources • Relies on potentially expensive infrastructure • May be undermined by potential software and/or hardware compatibility issues • Requires constant IT support • Pre-supposes the existence of a certain degree of computer literacy • Leaves student work vulnerable to exploitation by others • Lacks the immediacy and intensity of a physical social environment • May generate fewer or more superficial solutions • Generates a higher workload for tutors • Increases the workload of administrative staff • Requires a significant amount of bandwidth • Involves the mandatory digitisation of design solutions

2.3 Comparison and opportunities for improvement

As already mentioned, there are many similarities between the traditional and the virtual design studio environment. In both cases the design process follows the same stages, reflection is encouraged, and so is the sharing of knowledge among students. Both methods are focused on solving a specific design problem (in the course of completing a design assignment), and involve requesting and

reacting to regular feedback from both peers and tutors. Other common elements include lectures, the public defence of students' final designs, and the evaluation of the latter by a panel of experts. Nevertheless, there are also important differences between the two studio methods. The class size in a VDS environment can be much larger than that of a typical classroom-based design studio. Furthermore, in a traditional setting, the assignment is discussed in a physical classroom; in a VDS context, it is published and discussed online. As a result, the responsibility for the effectiveness of the educational process shifts from the tutor to the students who must self-manage their workload and the time spent in the studio space. Additionally, feedback is sought and given on digital drafts that are often computer-generated from the very early stages of development, and all subsequent alternations of the design involve the manipulation of digital objects; the associated communication (which may be synchronous, asynchronous, or both) is conducted exclusively with the help of ICT. While peer learning through mutual support is present in both settings, in a virtual setting it is secondary to learning by viewing and reflecting on other students' work. Finally, in VDS, the final designs are submitted in a digital format for online assessment, while the traditional studio solution commonly uses models and detailed drawings (Table 3).

Table 3: Comparison between traditional design studio teaching and Virtual Design Studio

Traditional Design Studio	Virtual Design Studio
Design Brief	
<ul style="list-style-type: none"> • Introduced and discussed in a face-to-face setting • Focused on the development of individual solutions to the design problem 	<ul style="list-style-type: none"> • Published and discussed online • Focused on group work
Design Process	
<ul style="list-style-type: none"> • Face-to-face meetings of tutor(s) and students • Variety of media, including computer tools • Informal gatherings of students to discuss the design problem during studio hours • Spontaneous desk-crit feedback on rough freehand sketches • Peer learning by collaboration • Tutor-directed learning 	<ul style="list-style-type: none"> • Meetings using high-bandwidth video conferencing • Digital media only • Asynchronous communication via e-mail, fora and discussion boards, and synchronous informal live chat or instant messaging • More structured feedback on computer-generated models and images • Peer learning by viewing and reflecting on contributions from others • Student-directed learning
Evaluation	
<ul style="list-style-type: none"> • Synchronous assessment in a physical setting • Panels consist of local experts and tutors • Portfolios consist of physical models and drawings 	<ul style="list-style-type: none"> • Online synchronous and/or asynchronous assessment • Panels consist of geographically distributed experts and tutors • Portfolios consist of computer-generated images and models

These features suggest that the effectiveness of a VDS-based course depends on the level of familiarity of the participants with ICT, as well as on the manner in which a number of additional issues are addressed; these include the high cost of computing equipment, the need for constant upgrades and technical support, the occasional lack of compatibility between different applications, the potential unreliability of a large number of online sources, etc. The evaluation stage has the potential to prove particularly problematic, as the interaction between participants may fail to match the richness and immediacy available in the traditional design studio due to limited screen resolution, insufficient bandwidth, and - most importantly - the psychological and practical constraints imposed by virtual communication.

3 METHODOLOGY

One possible solution to the problems associated with the provision of online design courses could involve the use of the deviantArt social platform as a VDS environment. Created in 2000, dA defines itself as *"an online art community for artists and art lovers to interact in a variety of ways, ranging from the submission of art to conversations on a number of topics. In its purest form, deviantART is a means for expressing yourself in a variety of ways"* [11]. Members can post their artwork; comment on, critique, and favourite other members' artwork; interact with other each other through the forums and chat rooms; create and join interest groups related to styles of art, television shows, favourite places etc.; receive member and group updates; and even buy and sell artwork through the dA online store. The goal of these features is to promote cross-cultural dialogue and collaboration between members,

as well as to provide artists with exposure, support, and learning tools and resources [33]. In that sense, dA could also be exploited to facilitate peer learning and distance assessment.

In order to assess its effectiveness as a supplement to VDS, dA was used as a delivery platform for a postgraduate distance-learning course in Graphic Design at the Hellenic Open University. The pilot project ran for 3 years (2010-2013) with a cohort of 150 students (50 students per year) and three tutors. Students, who came from a mixed background of disciplines including art, design, computer science, and media studies, were divided into 3 geographically based groups which were assigned their personal tutor for optional face to-face tutoring meetings; however, the 3 groups were unified and treated as one in the context of VDS. As the face-to-face tutorials took place in different cities, students who belonged to different groups never met each other in person.

The course's evaluation consisted of a final exam at the end of the course and 5 monthly design assignments set up in dA. The latter required students to post their sketches and design proposals to an interest group (GTP-EAP), which was created specifically for that particular course by staff (Fig. 1). Apart from uploading their work, group members could also see each other's work, comment on it, and read the comments left on all submitted work. Each assignment had its own folder and was open to all dA members in order to strengthen the institution's public presence in the design community, function as a shared resource for use and discussion by all participants, attract feedback from other artists, and help students overcome their fear of public exposure.

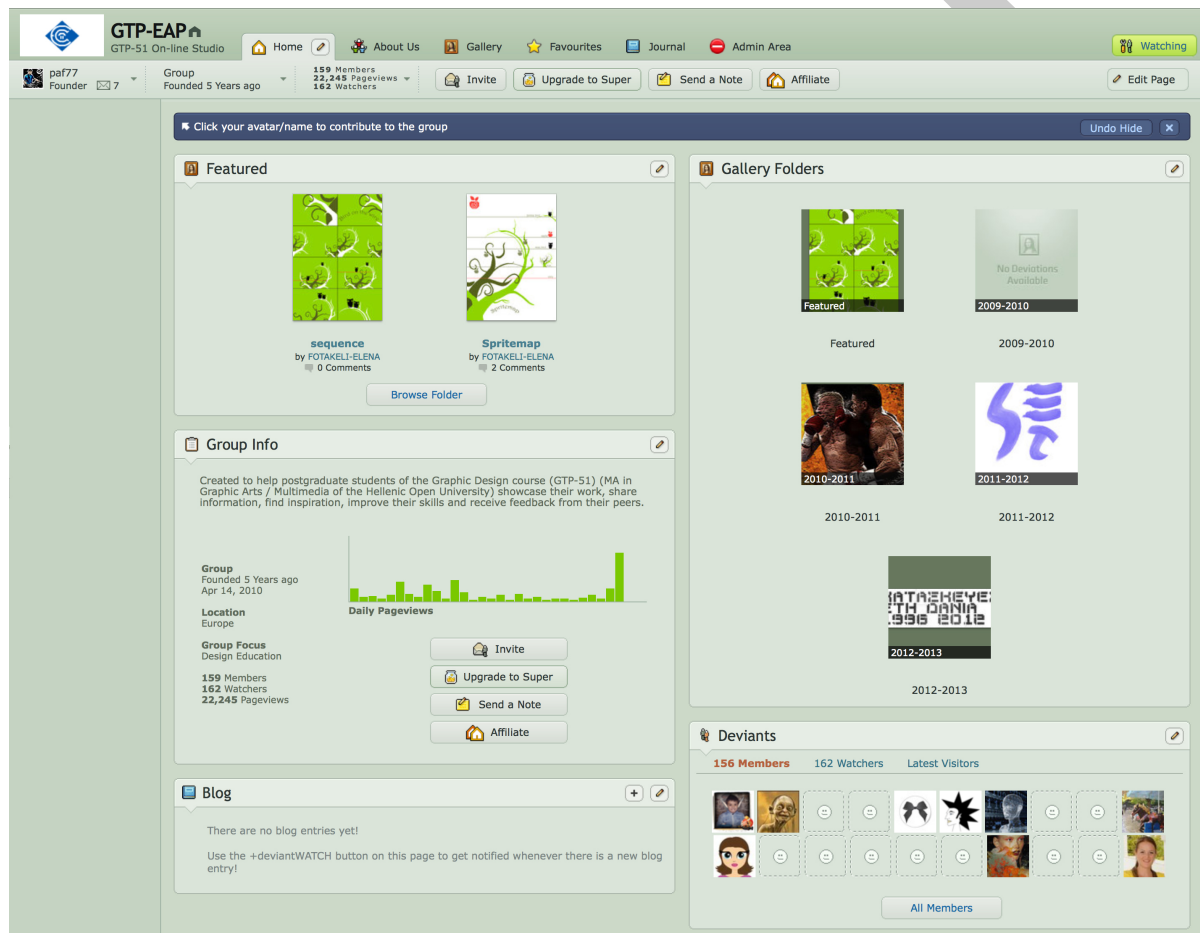


Figure 1: GTP-EAP deviantArt group

In order to assess how dA influenced the communication, learning and interactions of the participants, both formative and summative monitoring of student engagement were performed at the end of every academic year using the following methods:

- Collection of administrative data;
- Focus groups discussing the overall user experience from a usability perspective;
- Interviews conducted with the tutors in order to get their thoughts on the experiment's impact;
- Students' self-report of activity through semi-structured online interviews and a final survey measured on a Likert scale of 1 (Strongly Disagree) to 5 (Strongly Agree) (Fig. 2).

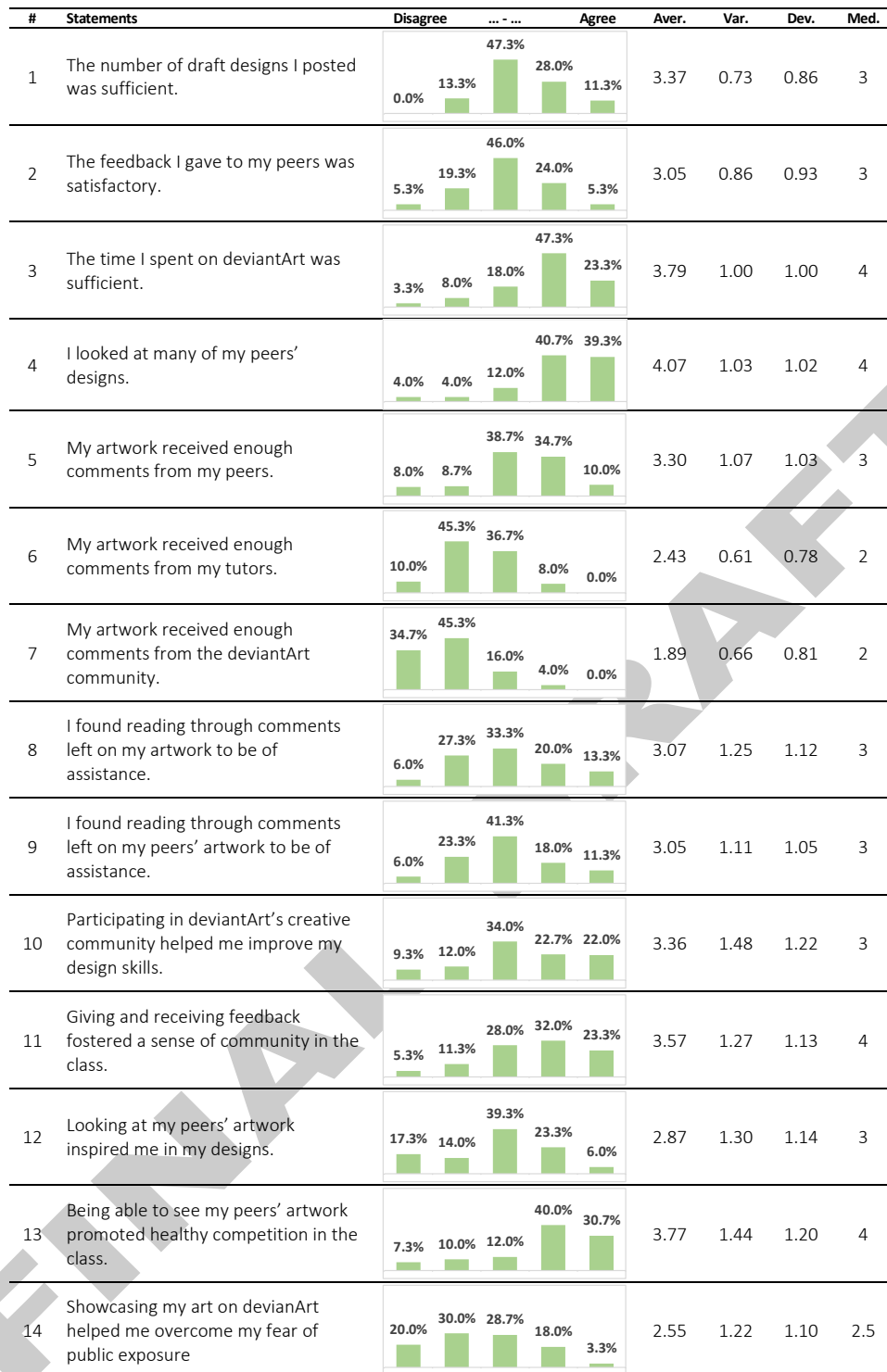


Figure 2: Survey results

4 RESULTS

Aiming at gauging student persistence, interest, and engagement in the dA pilot project, data regarding the number of uploaded images, comments, and page views was gathered on an annual basis. In a cohort of 50 students per year, an average of 34 students (68%) participated in each activity and submitted their design assignments. 725 images were posted on average every year, ranging from 65 to 352 images per assignment, with each contributing student uploading an average of 4.3 images (drafts and final design) per assignment. The project gathered an average of 6,433 page views per year both from the wider community and from the participants themselves. As dA provides

no statistics on the amount of feedback received in a group, the total number of comments per image had to be calculated manually, which proved to be a painstaking process. Overall, each image received an average of 3.2 comments. However, upon inspection it appeared that many images were left without any comments; this situation generated a degree of unhappiness among the students, as the availability of feedback from peers was seen as an important and necessary part of the design studio process.

Participant motivation was highest for the first three assignments of each year, which saw the largest number of comments on the design proposals being posted by tutors and students alike. The data clustering in Q6 suggests that the drop-off in tutor comments for later submissions was a major reason for this dissatisfaction. Whilst this is understandable due to the tutors' workload, steps should have been taken to manage student expectations better. Students' own participation also reduced towards the end of the semester, probably due to the fact that posting material online seemed too time consuming in a period when they had to prepare for their final exam. As evidenced in the interviews, the students' reaction to this development was largely negative, since the ability to receive feedback from both tutors and peers, and therefore see one's work from different perspectives had been one of the main attractions of this experiment. Q7 seems to suggest that students had higher expectations in regards to the volume of comments on their work compared to what actually happened. It may be worth investigating ways to motivate participants to comment more using aspects of gamification. Nevertheless, Q4, in combination with Q13, supports the assertion that the opportunity to access an overview of the group's portfolios and to compare one's work with that of one's peers is regarded favourably. Anecdotally it appears this process was of most use to weaker students, especially those with backgrounds not related to arts or design, since it facilitated their understanding of the assignments and the assessment criteria. However, these weaker students stated that posting their work was an intimidating experience, because they feared their designs would look subpar compared to those of their artistic peers. In general though, the overall reaction by the interviewees was very positive, as can be demonstrated by the sample of responses below:

- "Looking at designs from previous cohorts helped me get a better understanding of what I had to do in my assignments."
- "Seeing better designs than mine sent me back to the drawing board."
- "I got the chance to communicate and exchange ideas with students I had no previous contact."
- "Participating in dA's creative community was a rewarding experience."
- "I have now created an online portfolio that I could use to get a job."

The findings from the focus groups suggest that while the system performed adequately on the technical front and no specific improvements appear necessary, the user experience would benefit from further refinement. For example, the ease with which students could upload images to different folders (by design or by accident) at all stages of the process, made it sometimes difficult for participants to browse images and identify the design stage to which they relate, particularly in the context of the large number of total overview screens, individual images and comments. It might be helpful to devise and deploy clear naming conventions for both files and folders to minimize this risk.

Furthermore, neither the content nor the existence of comments were visible on the overview pages, and they were only revealed by visiting the detailed view page for each item. Consequently, accessing comments was often a time consuming endeavour, as it required students to repeatedly visit each individual design page. This issue could easily be remedied by the inclusion of comment counters in the overview pages.

An issue that was flagged up during the tutor interviews regarded the geographically based work groups. Since students were treated as a single cohort within the VDS and assignment folders contained a large number of images, it was relatively difficult for tutors to identify the designs submitted by the students belonging to their particular tutorial group. An ability to allocate students to groups and to display the portfolios accordingly would be most welcome, as would the ability to sort designs by author in order to gain an overview of each student's portfolio and the relevant comments. Additionally, tutors complained that providing feedback not only on the students' final designs but also on their drafts was a demanding that considerably increased their workload. However, they all agreed that the use of dA as a learning environment and social communication platform made a substantial contribution to the course's learning outcomes.

Finally, an overall critical review of the course's delivery via dA based upon the interviews, focus groups, and the qualitative analysis of the final survey data is summarised in the following table.

TABLE 4: Critical review of the use of dA group GTP-EAP in teaching the course "Graphic Design".

Strengths	Weaknesses
<ul style="list-style-type: none"> • Allowed the creation of public portfolios • Helped students overcome their fear of public exposure • Facilitated social interaction among all participants • Strengthened the institution's public presence in the design community • Encouraged students to reflect on their practice in a wider artistic context • Facilitated peer-reviewing • Fostered a sense of community • Provided users with an overview of student portfolios 	<ul style="list-style-type: none"> • Was somewhat undermined by inconsistent levels of engagement with the peer-review process • Was somewhat undermined by dwindling participant motivation • Suggested that the public nature of the feedback may intimidate certain participants • Proved relatively time consuming • Increased the workload of tutors

5 CONCLUSIONS AND FUTURE WORK

Teaching design to a multi-disciplinary group of students in a distance education context, which is marked by the lack of an established physical community of peers and by limited opportunities for face-to-face tuition, is a significant challenge. A major advantage of using the dA platform in a design course is providing students with both creative stimuli in the form of the work of their peers and with peer-review comments. Students are allowed to create public portfolios and get public exposure, which can potentially attract future employers. Furthermore, the use of such a social platform fosters a sense of community, a situation that may prove otherwise unattainable were one to rely solely on the small number of voluntary face-to-face meetings available as part of the formal structure of the distance learning course. Finally, dA allows students to make their voices heard as well as to listen to other views. Although there are still some issues to overcome, such as the degree of student involvement in terms of the amount of draft designs and feedback posted online, and the tutor workload, initial results obtained from this experiment were very encouraging. In further development of this research, there are plans on a set of new experiments that will explore the use of additional social media such as Facebook, Twitter, and Pinterest.

REFERENCES

- [1] Chen, W., and You, M. (2010). Student response to an Internet-mediated industrial design studio course, *International Journal of Technology and Design Education*, 20, pp.151–174.
- [2] Schön, D.A. (1988). *Educating the Reflective Practitioner*. London, UK: Jossey-Bass.
- [3] Brocato, K. (2009). Studio based learning: Proposing, critiquing, iterating our way to person centeredness for better classroom management, *Theory Into Practice*, 48(2), pp.138-146.
- [4] Schadewitz, N., and Zamenopoulos, T. (2009). Towards an online design studio: a study of social networking in design distance learning, in *International Association of Societies of Design Research (IASDR) Conference 2009*, Seoul, South Korea, 18-22 Oct 2009.
- [5] Shao, Y.J., Daley, L., and Vaughan, L. (2007). Exploring Web 2.0 for virtual design studio teaching, in *Proceedings of ascilite 2007*, Nanyang Technological University, Singapore, 2 – 5 December 2007. [online] Available at: <http://www.ascilite.org.au/conferences/singapore07/procs/shao.pdf>. [Accessed 5 April 2014]
- [6] Dave, B., and Danahy, J. (2000). Virtual Study Abroad and Exchange Studio, *Automation in Construction*, 9, pp.57-71.
- [7] Schnabel, M.A., and Ham, J.J. (2014). Learning Cloud: Architectural Education for the 21st Century, *International Journal of Architectural Computing*, 3(12), pp.225-241.
- [8] Schnabel, M.A., and Ham, J.J. (2012). Virtual Design Studio Within A Blended Social Network, *Journal of information technology in construction, Special Issue*, 17, pp.397-415.
- [9] Tinmaz, H. (2012). Social networking websites as an innovative framework for connectivism, *Contemporary Educational Technology*, 3(3), pp.234-245.
- [10] Marin-Diaz, V., Martinez, A.I.V., and McMullin, K.J. (2014). First Steps Towards a University Social Network on Personal Learning Environments, *The International Review of Research In Open And Distributed Learning*, 15(3). [online] Available at: <http://www.irrodl.org/index.php/irrodl/article/view/1679/2910> [Accessed 20 May 2015]

- [11] deviantArt (2015). *About deviantArt*. [online] Available at: <http://about.deviantart.com> [Accessed 20 May 2015]
- [12] Maher M.L., Simoff S.J., and Cicognani A. (2002). The potential and current limitations in a Virtual Design Studio, *VDS Journal*. [online] Available at: <http://www.arch.usyd.edu.au/~mary/vdsjournal> [Accessed 13 February 2014]
- [13] Wojtowicz, J., Seebohm, T., and Wright, R. (2001). Project 3E: Computational Support Mechanisms for Spatial Literacy, *Education: Evaluating Computer-Assisted Spatial Literacy Learning Environments*. [online] Available at: http://n-rhino.ald.utoronto.ca/vds_site/ [Accessed 11 February 2013]
- [14] Piaget, J. (1954). *The Construction of Reality in the Child*. New York, NY: Basic Books.
- [15] Von Glaserfeld, E. (1989). Cognition, construction of knowledge, and teaching, *Synthese*, 80(1), pp.121–140.
- [16] Vygotsky, L.S. (1985). *Thought and Language*. Cambridge MA: The M.I.T. Press.
- [17] Vrasidas, C., Zembylas, M., and Petrou, A. (2005). Contemporary learning theories and educational technologies, in Retalis, S. (ed.). *Technology and learning*. Athens, Greece: Kastanioti Editions, pp.35-58 (in Greek).
- [18] Palloff, R., and Pratt, K. (1999). *Building learning communities in cyberspace: Effective strategies for the online Classroom*. San Francisco, CA: Jossey-Bass.
- [19] Earl, M. (2001). Knowledge Management Strategies: Toward A Taxonomy, *Journal of Management Information Systems*, 18(1), pp.215-233.
- [20] Cuff, D. (1992). *Architecture: The story of practice*. Cambridge, MA: The MIT Press.
- [21] Hetland, L., Winner, E., Veenama, S., and Sheridan, K.M. (2007). *Studio thinking: The real benefits of visual arts education*. New York, NY: Teachers College Press.
- [22] Kvan, T. (2001). The pedagogy of virtual design studios, *Automation in Construction*, 10(3), pp.345–353.
- [23] Dillenbourg, P. (1999). What do you mean by 'collaborative' learning?, In Dillenbourg, P. (ed.). *Collaborative-learning: Cognitive and Computational Approaches*. Oxford: Elsevier, pp.1-19.
- [24] Austerlitz, N., and Sachs, A. (2006). Community Collaboration and Communication in the Design Studio, *Open House International*, 31, pp.25-32.
- [25] Fiedler, S. (1999). *The Studio Experience: Challenges and Opportunities for Self-Organized Learning*. Athens, GA: The University of Georgia, Department of Instructional Technology.
- [26] Kuhn, S. (2001). Learning from the architecture studio: implications for project-based pedagogy, *International Journal of Engineering Education*, 17(4-5), pp.349–52.
- [27] Lackney, J.A. (1999). *A History of the Studio-based Learning Model*. [online] Available at <http://schoolstudio.engr.wisc.edu/studiobasedlearning.html> [Accessed 11 February 2013]
- [28] Moggridge, A. (2007). *Designing Interactions*. Cambridge MA: The MIT Press.
- [29] Craig, D.L., and Zimring, C. (2000). Supporting collaborative design groups as design communities, *Design Studies*, 21(2), pp.187–204.
- [30] Wang, L., Shen, W., Xie, H., Neelamkavil, J., and Pardasani A. (2002). Collaborative conceptual design-state of the art and future trends, *Computer-Aided Design*, 34, pp.981-996.
- [31] Bender, D., Wood, B.J., and Vredevoogd, J.D. (2004). Teaching Time: Distance Education versus Classroom Instruction, *American Journal of Distance Education*, 18(2), pp.103-114.
- [32] Zimring, C., Khan, S., Craig, D., Haq, S., and Guzdial, M. (2001). CoOL Studio: using simple tools to expand the discursive space of the design studio, *Automation in Construction*, 10, pp.675-685.
- [33] Drake, L. (2012). *Negotiating Identity in Online Contexts: A Look at the deviantART Community*. Undergraduate thesis, University of Florida [online] https://www.academia.edu/1551862/Negotiating_Identity_in_Online_Contexts_A_Look_at_the_deviantART_Community [Accessed: 20 May 2015]