

Integrating Mobile Device Applications into Designers' Workflow

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Abstract: The concept of smart device apps is a global phenomenon that has transformed the electronics industry in recent years. The industry is now worth billions and is extremely profitable if the app is right. Apps are transforming how people organise themselves and work. Apps can be found that perform some of the most niche tasks and industry specific apps are on the increase. This study examines how apps can become tools to the practicing product designer by analysing the design process. Surveys were sent out to both student and professional designers. It is acknowledged that there are no apps dedicated specifically to product designers and most designers were not making use of their smart device as a design tool. It was also learnt that tablet market penetration (UK) is set to increase to 35% by 2015 which could mean there will be an increased need for apps as design tools. This work uncovered many different ideas for apps which could specifically be useful in the product design process. This could mean that when the market is ready, there is a lot of potential for apps to be used as design practice tools.

Keywords: Design Thinking, Design Education, App, Smartphone, Smart device, Creative, Design.

1. Introduction

The past decade has seen the rapid development of small programs known as 'Apps' that run on smart devices such as smartphones and tablet PCs. In recent years, smartphone's and tablet computers have surged in popularity and an app has now become more than a colloquialism for a computer application and a revolutionary industry worth billions. Smart devices are portable electronic computers that host an operating system (OS) environment, in the same way in which Windows runs on a computer. A current example would be the Apple iPad that hosts the iOS operating system that now operable on an estimated 316 million devices (Stat Spotting, 2012). In April 2012, the social media company Facebook announced the purchase of the app Instagram for \$1billion (£630million) (BBC, 2012).

The value proposition for the 'App' business model is the fact that almost any task can be emulated on a device at a low production cost. The consumer gets the added value of functionality and expandability to increase their products service-life. The developer has the benefit of a large user-base and none of the overheads of manufacturing their own device and OS vendor also gets a percentage of the App's retail price, which makes the ongoing development of the operating system worthwhile. This research considers on the end user as a designer. The app revolution has opened up plenty of opportunities for designers to capitalise financially with their creative ideas but how can apps themselves help designers, design?

1.1 Aims

The aim of this work is to identify if apps are currently being used in a student/professional designers workflow and to explore the possibilities of how professional and student product designers could integrate smart device apps into their design workflow. It serves as an investigation into the potential opportunities by collecting the opinions of others.

1.2 Objectives

In order to fulfil this aim the following objectives have been identified.

1. To review relevant media on the emerging subject of mobile application design.
2. To divide the product design process into individual activities and explore the 'essence' of each one.
3. To define the product design process for the context of this research using the most up to date design thinking methods and categorise them under the four D's (Design Council, 2005).
4. To acquire an industry perspective on the current relevance of smart device apps as professional design tools and possible future integration into their design workflows.
5. To acquire a student perspective on the current relevance and potential use of smart device apps as design education tools at degree level.

- To suggest how a smart device app could replicate or improve on that activity in the product design process.

2. Literature Review

There are many ideologies of what the design process should be yet there is no single one. Creative design agencies develop their own way of 'generating' creativity, normally built upon prior successes. From the many methods available, the most appropriate for this research was methodology that has manageable sections with scope for expansion on individual design activities that can be analysed for their adaptability for apps. A simple ideology is the design thinking 'Method Index' shown in Figure 1 created by the agency IDEO, it uses five simple headings to describe each stage of the design process, they are; Discovery, Interpretation, Ideation, Experimentation and Evolution.

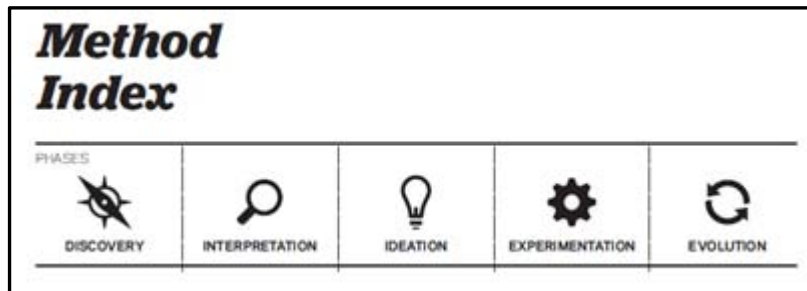


Figure 1. Method Index (Riverdale/ IDEO, 2011)

The ideology is detailed and provides detailed resources on activities that are typically undertaken for each stage. This makes it the most succinct process found and the organisation IDEO is an established company in the international design community. "... We're not actually expert at any given area. We're experts in the process" (Kelly, 1999). "The design process is what puts design thinking into action. It's a structured approach to generating and developing idea" (IDEO, 2011).

The experimentation phase is there to make ideas tangible – creating prototypes with the goal to learn whilst building. This is usually a very physical process that involves a lot of 'retro' fitting and fabricating parts to make a representation of the product idea. It is also a good idea to have more than one as not to put all your eggs in one basket so to speak. The prototypes then require feedback. It is important that honesty is encouraged. Something that is quite difficult is to present

the ideas with a neutral tone to keep the feedback unbiased. Another good example of the design process is the four D's: "Discover, Define, Develop and Deliver" shown in Figure 2, this process is succinct and memorable. It is also a very general process that can be applied to many different disciplines.

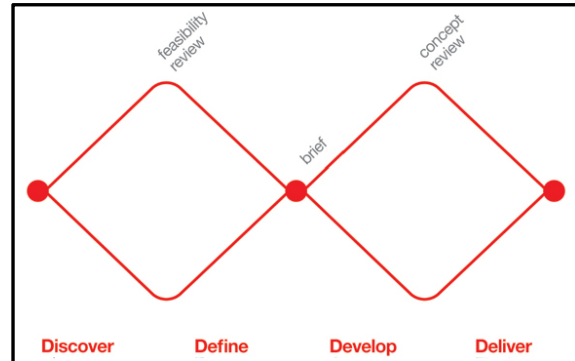


Figure 2. Design Process (Design Council)

An interesting design method by IDEO is "Affinity Clusters" (Bramston, 2009) which uses post-it notes to mind map ideas, digital possibilities for this are mat be considered. Another relevant article was published in 2007 and is focused on the computer program Sketchbook Pro by Autodesk that was running on a tablet PC (Chin, 2007). A limitation of Chin (2007) is that 'design thinking' is insufficiently addressed and focuses on 'sketching'. Sketching is nevertheless a very significant part of the product design process but many aspects of design thinking are left unaddressed (Thorsteinsson, and Niculescu, 2012). Chin (2007), however, suggests ways in which a similar system could have applications in design education. For example, in design idea generation, development, direct student/teacher communication and presentation. However, the article not sufficiently detailed and makes are merely suggestions in its conclusion.

Franko (2011) focused on reviewing current apps available for practicing orthopaedic surgeons and highlighted the need for more novel apps to be developed. Although Franko (2011) is unrelated to design or apps for designers it does highlight the potential for future studies for profession specific apps, which could include product designers. In literature and online articles/blogs, a typical list of apps labelled with the keywords 'creative' or 'designers' will be quite general for public appeal. For example, in a recent issue of 'Apps' magazine a top 10 list is featured aimed at creative people (Imagine-Publishing, 2012, p. 30) but the apps they suggest are very general and apply to all forms of creativity including photography and music creation. There seems to be a lack of product design and design thinking tools on the market. It has to be remembered that magazines such as "Apps" are for a wider audience, so are unlikely to publish niche applications that do not have wider public appeal.

Paper is an app released for iPad on 29th March 2012 by FiftyThree, a creative development company based in New York and Seattle. The company aim is to "create tools for the creative space" and they are quite vocal in their disappointment of the current selection of apps available for creative work.

"Personally, we were getting a bit frustrated right. Now we have all breakthroughs in mobile technology and connectivity, and what we really got was mobile email, twitter and Angry Birds" Georg Petschnigg, *Fifty Three* (Hamburger, 2012).

The app is a creative tool designed to allow fluid and expressive documentation of ideas, a virtual notebook. The app makes use of the iPad's touchscreen interface to allow the user to navigate digital notebooks in the app seamlessly as if they were using a physical book. What makes this app different from similar documenting apps is the attention to detail about how creative people and designers work. A useful feature of this app is the ability to organise notes in a logical way. The app allows the user to setup and personalise note books. This allows the designer to keep a book for each of the projects they are working on and it is designed to work with the user. The team at FiftyThree also innovated the 'undo button and have made it a 'rewind' gesture.

There could be a research project dedicated to the importance of interaction design to help fluidity and creativity. The App provides an intuitive

navigation and offers the user with the necessary tools to make fluid notes. The app also includes a number of interface innovations such as a "rewind" gesture instead of a standard back button to increase the users' perception of control over the canvas. The CEO, George Petschnigg said in an interview for The Verge (Hamburger, 2012) how the range of apps available for creating is "frustrating" and that their company is focusing on creating tools that "help people work with their ideas" – this is further proof the emerging topic of application design is becoming increasingly relevant for designers.

3. Research

3.1 Research methods

The research methods are qualitative because the subject matter is emerging as an academic topic there is an emphasis on exploration. There are no right or wrong answers but there are an acquisition of insights. Any plans for research cannot be tightly defined initially, "questions will change during the process of research to reflect an increased understanding of the problem" (Creswell, 2007, p. 43). Creswell refers to this type of research as an "Interpretive enquiry", where the researchers interoperate from what they see and hear from participants. This may generate conflicting views on a topic; this is useful because it fuels discussion.

The primary research comprises respondents from two areas of product design; professionals and undergraduate degree level students. In the hierarchy of research relevance, a professional designers' opinion will be more valued as their industry experience and time could be seen as a greater value to the research. This in turn may lead to more insightful discoveries. There is an opportunity to collect data from students through the circulation of online surveys. This is beneficial as data samples can be collected from a large population of students available on social media and discussion websites, at relative ease.

3.2 Defining the user

The 'user' for the scope of this paper will be product designers both by education and profession. "Design education" will be classified as undergraduates in Industrial or Product Design and Technology. A "design professional" is classified an individual who works within the product design industry. In

many cases these will overlap each other, as design practice techniques are taught at university and then students will work with them on a professional level.

3.3 Research results

3.3.1 Student respondents

The questionnaire was sent one hundred and thirty nine students at Loughborough Design School. Out of these, thirty five replies were received. This is a response rate of twenty five percent which is just above the average response rate of twenty percent for a public survey. The results were from students who study Industrial Design and Product Design and Technology at Loughborough University. Figure 3 shows that eighty five percent of the respondents owned a smart phone or tablet.

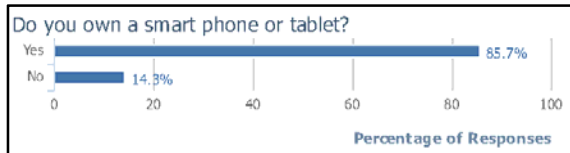


Figure 3. Smart device usage among participants

When asked what operating system they have access to; fifty percent used iOS, thirty three percent used Android and seventeen percent selected 'other' stating they had access to iOS and Android operating system (Figure 4). These statistics are broadly in line with current market shares for smart devices with iOS and Android being the top two.

The participants were then asked to abridge the design process into just five steps. Table 1 shows IDEO's methodology and the methods in which students would approach design. This is interesting as a comparison between how

different students perceive the design process. This could be because they were all taught in the same school and could be considered as a limitation of the study. The five initial stages are quite similar across the board between student designers. Comparing column one, it can be seen that there is a consistency between everyone's initial approaches. The main trend is research and observation, varying between market, brand and user research. A common trend by the students is 'concept generation' and initial designs. Activities in column three are a mix of development and modelling. The common theme in column five is refinement, final development and production.

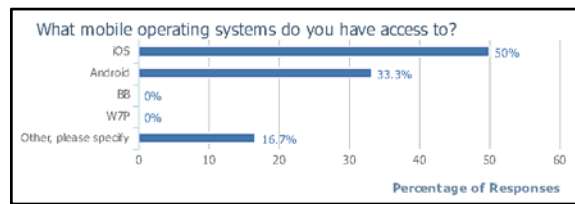


Figure 4. Operating system usage among participants

When participants were asked if they used their smart device in their design workflow– it was a near equal split between those who did and those who didn't. Those who did used their device for basic computing tasks such as email, web browsing and to take notes. Some also used their device to take photographs of prototypes and email them to people. What was surprising was that no one used their device for drawing, which may be considered the most common task related to a designer. There is already software available to do this (Autodesk, 2012). When the participants were asked how they could see apps as a tool for the rest of their design education or profession the common

Table 1. IDEO's Design Methodology

	1	2	3	4	5
IDEO	Discovery	Interpretation	Ideation	Experimentation	Evolution
A	Initial research	Concept generation	Concept Evaluation	Concept Development	Final development
B	Idea	Research	Development	Prototype	Refinement
C	Research into Market, user and need	Initial Design and test to fit the market	Functional development	Aesthetic Development	Prototyping
D	Define Brief	Concept Generation	Modelling/prototyping	CAD prototyping for production	Testing
E	Observe	Research	Insight	Innovate	Develop
F	Market research	Initial ideas	Development Prototyping	Product Engineering (CAD stage)	Production
G	Brand Research	Shaping ergonomic	Usability	Detailing design	Colouring & Material

Table 2. Student answers categorised into the Four D's methodology.

Discover	Define	Develop	Deliver
Brainstorming	Collaborative brainstorming	Detailing	Testing
Observations	Sketching	Sketch work	CAD / CAM
Questionnaires	Component Research	Foam modelling	Fully working model and test
Primary research	Technology Research	RP, Card models	Colouring & Material
Research into the market	Ideation as part of a group	3d and virtual prototyping	
Talk to client			
Talk to user			
Ethnographic Research			

themes were: communication and sharing; data collection and camera based applications; presenting; sketching; and as a tool to exchange sketches/CAD renderings more easily. A few participants appeared to not be inspired by the potential of integrating apps into their workflow simply replying "I don't". Students were asked the types of design activities that they would typically conduct on a design project. Table 2 shows their answers categorised into the Four D's methodology.

3.3.2 Industry respondents

With regard to the survey of design industry professionals a questionnaire was sent to fifty designers. Out of these, eleven replies were received. With a small sample size such as this, caution must be applied. The design industry professionals were asked to rank qualities that make a good designer as shown in Table 3. The results show the three highest ranking skills that a designer should have are: creative ideas, problem solving ability and communication skills.

Table 3. Participants ranking of a designers most valuable skills (lower = better)

Ranking	Skill	Raw Score
1	Creative Ideas	2.0
2	Problem Solving Ability	3.2
3	Communication	4.6
4	Technical Process knowledge	5.1
5	Sketching ability	4.1
6	Team Working	5.3
7	CAD ability	6.7
8	Business Acumen	7.7
9	Interviewing skills	9.1

The survey still, however, provided some good insight into the professional design process. Table 4 shows some of the participants

suggested activities, categorised into the Four D methodology.

Table 4. Suggested activities by categories

Discover	Define	Develop	Deliver
Briefing	Reasons for the product to exist	functional testing	Metrology
Gathering business needs	Gathering business needs	user testing	Non-rapid prototyping
Consumer needs	Sketching	RP	Engineering drawings
	Concept development	Basic CAD	CAD
		Sketch modelling	Engineering refinement
			Rendering

Table 5 shows responses by participants to the question whether they use their smart device in their current design workflow. One person uses Sketchbook Pro and wishes to have a bigger screen. The other participant uses their phone for admin such as email and calendar. Figure 6 asks how the participants imagine apps will feature in their workflow. Some interesting insights are a CAD viewer and presentation device as tablets become more powerful.

Table 5. Professional participants' opinions on the future of apps

Does your smart phone (or tablet) currently feature in your design workflow? And if so, how? (e.g. pictures, Skype, drawing)	
A	I use sketchbook pro to draw out ideas I have when I don't have paperEtc like on a train. I would use it much more on an iPad with biggerScreen!
B	It rings, I talk. It's a phone after all; however the calendar and email functions mean I always have my email & diary with me. The camera is essential to record images of products or ideas or things clients want to show you, Skype is handy and have a mans of always having a portfolio me is useful occasionally

Table 6. Do professional participants currently use their smart device for design

How do you imagine yourself using such a device in the future as a tool for your profession? (e.g. communicating with consumers, sharing ideas with other designers)	
A	I'd like to see a full featured CAD viewer from each major cad software vendor. I'd be interested to see full feature modelling on a touch screen device (only on larger screens though) I'd like to be able to take a cad model into a meeting on an iPad in a real time rendering app, to quickly change materials, colours etc. and for it to appear on screen - like the keyshot environment.
B	Working in the cloud or having access to it as the processors become more powerful the interface with fixed screens/projection technologies will become more important. The small size of the devices limits their group use. Once the graphics have the power to drive any viewing device the interaction will be much greater. Trending and data mining will increase though consumers may become resistant to this over time.

4. Discussion

4.1 Design apps & designers

Section 2 revealed that despite there being many general creative apps for purposes such as drawing and documenting there are no apps specifically designed for the practicing product designer. The research conducted showed that eighty five percent of the student designers asked owned a smart device. This result was expected as sales of smart devices are currently popular. The results also show that the most popular operating system was Apples iOS, closely followed by Google's Android.

An unexpected result of the research was how few of the student designers used their smart devices in their current work flow. Those who did, used them for basic computing and administrative tasks such as sending emails and taking photographs. None said they performed any task that may be classed as part of the design process. This raises an interesting question of; why? Well-developed sketching apps are in available for both Android and iOS platforms. One reason may be due to the infancy of the technology – students in particular may not have the skills or be financially viable enough in their design skills to incorporate these apps into their design work flow, it could be a case of walking before you run.

The education system may be a limiting factor as technology can take a while to trickle down into mainstream education. It could be said that

currently app downloads are socially driven (such as games connected to Facebook), which means that people only download the app due to its popularity amongst peers (e.g. Draw Something). There are no apps dedicated to the practicing product designer, unlike apps for orthopaedic surgeons. There are tools available but these tools are yet to really take a large role with in the design community (particularly students) Apps are in development to address the creative issues of designs such as what FiftyThree are attempting to achieve.

4.2 Design practice activities & app opportunities

4.2.1 Discover

To discover an idea is a difficult process to reproduce. Sometimes an idea will just come to people with a 'eureka' moment. The task that designers have to face is how to repeat this effect. When designers ranked their most important qualities in the research – creative ideas and problem solving came up tops. The research highlighted that the first step in design was in fact, research. Defining a problem or discovering an idea that is beneficial and worthwhile to develop is difficult. Design is all about the end user, the designer needs to identify a user and discover what problems they are having before a product can be developed to solve them. It is for this reason that documentation and absorbing information is important at this stage.

A large part of the 'discovery' process is observing and ethnographic research. The Research includes note taking, taking pictures and video of user interactions in their environment, to analyse for insights at a later stage. At the moment there seems to be a disjointed relationship between where the insights are documented and viewed. There is an opportunity now in the upcoming generation of tablet computers to combine the act of note taking and media viewing. In a similar way to how music is listened to on the media player on SoundCloud (figure 21) user annotations pop up expressing their enjoyment at a specific moment in the music. As a video is played back on the system, notes can be made and linked to the specific moment on the video timeline. Highlighting the insight 'in-action' makes it easier to communicate the idea for others to witness for themselves. Currently, this can be done in video editing software but that takes

skills and time. Note taking should be quick and easy and a tablet solution has the potential to allow for this.

4.2.2 Define

The 'define' stage of design is where the insights are captured and presented to create the value proposition of the future product. The "Insight Wall" is an idea that sprouted from the use of large expansive walls to display sticky notes and imagery about the task at hand IDEO call these 'affinity clusters' (Bramston, 2009) and it is a good way to collect and categorise insights. In a workshop environment the concept is useful to get all the ideas up on display; however this is not always practical for students who may be working collaboratively, as they may not have the luxury of space. Designers in industry can also be limited by the timeframe of the session to view all the collected ideas.

It may be the case when people have time to think – they over think and dismiss potential ideas without wanting to sound silly or stupid. Richard Seymour, a partner at Seymour Powell demonstrates this concept in his TED talk "How Beauty Feels" (TED, 2011). He gets the audience to draw the person next to each them, this results in laughter and many apologies. He makes the example that if you gave the same task to a child they wouldn't be worried about the social consequences of their drawing on other people.

4.2.3 Develop

The 'develop' process involves acquiring a lot of feedback from users and peers to remove any design issues. Taking this in mind apps may be good at acquiring unbiased honest feedback for designs. Sometime it can be the case that when designs are reviewed by peers, there is a bias based on not wanting to hurt the feelings of others. People may hold back their real opinions; this is an issue as if a design is flawed and continues to be developed – the amount of money wasted will increase exponentially until the flaw is realised. Omegle is an interesting communication tool. A system similar to this could set up for reviewing designs.

An example like this could be more beneficial. This method is easily scalable and not limited to friends/employees. Consumers can potentially be targeted through Facebook even, through descriptive keywords. This would mean that opinions are gained from the people

who truly matter to the type of product. A popular medium of designer/consumer communication in industry is called a 'focus group' this is where consumers are recruited to offer their opinions. These can be expensive to orchestrate for a student or small business, a method similar to Omegle's would be cheaper and easier to implement. Updates could be 'pushed' to the target consumers themselves in a split second without the need to take the time organising a focus group session. This could lead to better design due to quicker, more relevant consumer feedback whenever a design change is made. However a system like will not replace focus groups. The design process is personal and there needs to be a relationship between the designer and consumer. Face-to-face sessions have the benefit of being able to elaborate and dig deeper on comments made by people. A system such as this could complement face-to-face sessions to enhance customer relationships.

4.2.4 Deliver

Communication was highlighted the third most important skill to a designer. Communication features in all stages of the design process. In the delivery stage presentation is vital and smart devices such as the iPad are perfect for on the go presenting due the large screen and portability. Using a smart device as a presentation came up in the primary research. As discussed in the Prezi case study there are apps in development that are creating this experience, it appears that in the future, when tablet market penetration is higher more and more people will be using tablets as presentation displays. In an education environment, students could create their presentation then plug it into a projector to make presentations to their tutors and peers. The system could go as far as to allow for real-time audience participation. Perhaps a poll based system such as "Who wants to be a millionaire" where audience participation is encouraged.

The research also highlighted a possibility for a real-time rendering app so that on-the-fly changes to variables like colour could be made at the wish of a marketer, for example. One of the most important skills for a designer is to present and also convince. It is often the case now with modern rendering programs that the "real-time" quality of a render is perfectly acceptable for presentations and having the ability to make colour adjustments is beneficial in communicating to non-designers to help

them visualise the concept. A concept like this could not yet be feasible on current generations of smart devices due to lack of processing power. However a participant in the research also suggested a cloud based system uses the resources of an external server to make the calculations needed to render.

4.3 Limitations of apps

It appears that there are a number of unavoidable downsides to apps as design tools. Many design processes involves creating tangible prototypes, an activity that smart devices will not be able to reproduce anytime in the near future. Design involves a lot of group activity which provokes discussion and emotional responses. Video calling apps like Skype are beginning to enhance the experience of communication but probably nothing will replace the connection and problem solving ability of a group of people brainstorming in a room, for the time being. It was also suggested in the research that smart devices are not powerful enough to compute CPU heavy applications such as 3D rendering presently. However, cloud computing is becoming increasingly popular and offloading CPU computations to the 'cloud' could make this feasible.

5. Conclusion

This research has attempted to investigate the current state of smart devices and the app industry in relation to product designers. It has attempted to categorise the activities that product designers perform in their workflow into four succinct headings. The study has then endeavoured to highlight ways in which these activities could be improved using new app concepts.

One of the more significant findings to emerge from this study is that despite the majority of designers owning a smart phone, none are using it as a tool to assist in their design process with the exception of standard admin tasks such as emailing and browsing the internet. It could be assumed that smart phones are not favourable for use in traditional design activities because of the small screen. Tablet computers however have a lot of potential due to having a larger 'canvas' (screen) but are not currently as widely used currently in 2012. However, tablet penetration is predicted to

increase to 35% of the UK population by 2015. This could mean more specialist apps will become available for industry specific apps, which could be the product design profession, following suit of apps for orthopaedic surgeons. (Franko, 2011)

It appears that apps for designers will be most beneficial to design for the following applications; communication; documentation; and presentation. It was discovered that a lot of the designer's processes were physical and required a certain level of tangibility such as prototyping models. The investigation highlighted the following possible functionalities of an app for product design (Page, 2011). The discovery process involves generating insights to lead to future useful products. The concept of open innovation and crowd sourcing could exploit the thoughts of millions of connected users to solve some of the world's pressing problems. Smart devices could modernise the ethnographic observation process by letting the designer annotate research video with timestamps. This would allow for the better communication of ideas within design teams.

The concept of the "Insight Wall" lets the designer navigate a potentially never ending space in which notes, pictures and video can be documented. This idea is similar to IDEO's process of getting all their ideas onto the walls for easy viewing. A concept such as this could be beneficial to student designers as they may not have a lot of space to work and collaborate. An issue that can arise with a 'peer review' is when peers are reviewing designs in an education environment; sometimes people will hold back their true thoughts in attempt to not hurt their friends' feelings, leading to bad design. With the power of apps, there is the opportunity to connect peers anonymously meaning that there is less confrontation and awkwardness. Smart devices have a lot potential as presentation aids. Apps such as 'CAD viewers' could demonstrate a product in 3D at almost any time. They would also help create a better understanding of the 3D visual form. Other potential benefits in the future as devices get more powerful or using cloud computing, 3D rendering software to make real-time changes to views to appease the wishes of stakeholders in meetings.

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