

Skeuomorphism or flat design: future directions in mobile device User Interface (UI) design education

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Abstract: Skeuomorphism in User Interface (UI) design has received much attention and criticism about its usefulness and purpose in the design of smartphone apps. The argument of whether or not skeuomorphism still has a place in UI design is explored in this paper. A questionnaire survey was undertaken by design students to establish their awareness of skeuomorphism and their opinion of its relevance in UI design. The results showed a lack of knowledge about the areas of UI design, but once fully explored they agreed that skeuomorphism is relevant but not as a stand-alone process. However, it has been identified as a design tool that may be used in conjunction with other processes as shown by Google UI design exploring skeuominimalism. They also come to state that they found the research was very useful to them in improving their knowledge on the topic and developing their skill set as a designer.

Keywords: skeuomorphism; flat design; user interface design; education.

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1 Introduction

Over the past few years, Apple's iOS and Mac OSX operating systems and applications (apps) have received much attention among design writers over the excessive use of skeuomorphic design techniques (Downer, 2012). However, the more recent release of Windows 8 operating system by Microsoft and its 'novel' UI design that has been named

'flat design' has sparked a debate over which approach is better and if skeuomorphism still has a place in UI design (Greif, 2013). Greif (2013) argues that the Apple design follows an approach of using realism with faux textures, drop shadows, visual metaphors and the direct use of skeuomorphism as opposed to the approach Microsoft have recently adopted with the rise of 'flat design' using minimalism and colour to express the intentions of the UI design (Hooten et al., 2013). Nevertheless, some designers are arguing the case that UI design should be neither one nor the other but instead should use them both as design tools. Furthermore, they may be used in conjunction with each other when and where it is relevant to get the best out of the design intent. This approach has been named 'skeuominimalism' and uses the best of both skeuomorphism and flat design (Baranuik, 2012).

The aim of this research was to examine and discuss skeuomorphism and to determine its future in UI design either as singularly or as a design tool used in conjunction with flat design to help the overall design process (Hashimoto and Clayton, 2009). Furthermore, this work explores and discusses flat design in opposition to skeuomorphism, and to give a wider perspective on the topic explores the idea of skeuominimalism and using skeuomorphic elements when designing a UI. It is expected that this will help designers understand the areas of UI design and allow them to make informed decision as to which design approach to use when creating their own designs.

2 Literature review

A skeuomorph may be described as an object or feature which imitates the design of a similar artefact in another material or technique. It may also be defined as an element of design or structure that serves little or no actual purpose of the product in the new material but was essential to the object being made in the original material (Basalla, 1988). In more simplistic terms, it could be used to described the way in which a design uses a feature from a past design even when the original function of the feature is no longer necessary (Greif, 2013). Skeuomorphic features may be found in use on a day-to-day basis, such as the pre-recorded shutter noises on smartphones used to let you know when a photo has been taken. This is skeuomorphic as the shutter noise was a feature of the original design of mechanical cameras but serves no purpose in a digital smartphone camera (Downer, 2012).

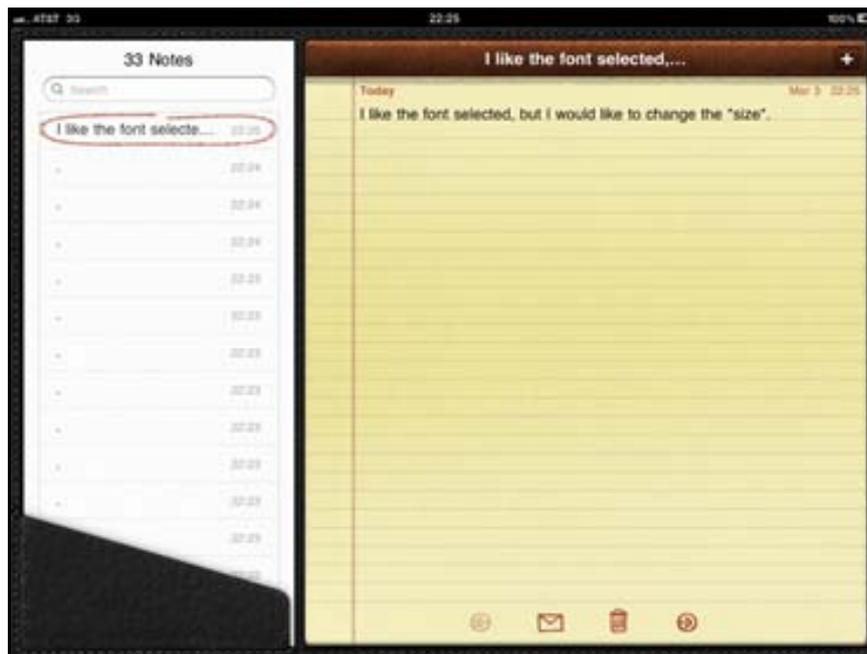
Norman (1988) stated that in order to understand where skeuomorphism originated, we have to look back to ideas of 'mimesis' and path dependence in technology where the functional behaviour is maintained and when the reason for its design is no longer relevant. Mimesis is both critically and philosophically used to describe a wide range of meanings, imitation, representation and mimicry. It may often be restricted to aesthetics or imitation, neither of which reveals the dimension of mimesis of the variety of meanings and connotations attached to the term. Mimesis is a human condition and plays a role in a wide variety of human thought and action (Wulf and Gebauer, 1995).

Mimesis may be seen in today's society as the aestheticisation of the world which is now perceived through the images of the mass media. They create ostensible realities through the use of images and video and due overexposure they become surrogate experience of reality and change the expectation and reality of society (Kelly, 1998). Mimesis allows individuals to step out of the ordinary and their own comfort zones to

draw inspiration from the outside world inside and to add cultural and social expression to their inner thoughts (Wulf and Gebauer, 1995). The process of imitation has always played a primary role in the examination of creative processes. Aristotle's *Poesis* states 'the natural human inclination to imitate is described as inherent in a man from his earliest days, he differs from other animals in that he is the most imitative of all creatures and he learns his earliest lessons through imitations' (Durix, 1998). Mimesis may be seen as something that humans and nature have in common that is embedded not only in the creative process but also in our DNA (Odom et al., 2008).

Digital skeuomorphs are more common in UI design due to the emerging boom in digital technology and use of the technique by Apple and application designers alike. Digital skeuomorph tends to be used in the form of graphical UIs that replicate objects in the real world; digital skeuomorphism can be traced back to the visual metaphor designers (Cyr et al., 2010). Over time skeuomorphism has seeped into all areas of UI design, especially in Apple's software, where text documents for example are made to look like yellow legal pads (Carr, 2012) as shown in Figure 1.

Figure 1 Example of a digital skeuomorph: Apple notes application (see online version for colours)



Some examples may be found in the music industry in editing and audio processing software such as Apple's Garageband application. This can be seen in the functional aspects of the UI within the controls such as knobs, buttons, sliders and switches, which have been replicated from the original designs of the physical devices, they are mimicking. Some even include design interface features that serve no purpose at all, such as handles, screws and stitching.

The current skeuomorphic design debate implies a connection to a past incarnation of a feature of a similar design is not always accurate but is actually often about realism (Greif, 2012b). The most common misconception of all is that a UI that contains realistic looking elements but does not actually mimic any physical object is skeuomorphic (Ziefle and Bay, 2006). In reality, it is completely aesthetical (Carr, 2012) as realism is a purely visual style. The word skeuomorphism is continually being misused; what is being called skeuomorphic is not actually skeuomorphic at all; they are kitsch visual metaphors (Baranuik, 2012). It could be referred to as 'realism' or 'simulacra'. This is when something is referred to the likeness of a real object but behaves differently which is commonly seen in current UIs when skeuomorphism is badly or incorrectly implemented into a design without sound decisions from the designer.

Another notable example of this is with Apple's 'Find my Friends' app that may be seen in Figure 2. On the surface, it is clad with faux textures of tanned Corinthian leather with stitched on tan and tool bars giving it the appearance of a poker table. As aesthetically similar as it looks to a real-life poker table, 'Find my Friends' is based on something completely fictional, meaning the features are not directly linked or used from one design to another, thus making it realism not skeuomorphism (Downer, 2012). It is because of UI designs like this that are creating negative impact on the way skeuomorphism is viewed in the industry when in fact they are just kitsch visual metaphors that are just bad designs.

Figure 2 'Find my Friends' app UI (see online version for colours)



Skeuomorphism may be used in many different ways to help familiarise users to a new product and technology. Society has reached a stage where it is constantly releasing new technologies and designs which are becoming increasingly interactive (Downer, 2012).

Thus, requiring the user to adapt the way they use products and skeuomorphism may be used to ease this transition into this new phase of increasing technological consumption (Brajnik et al., 2011).

It may be said that there is a validity to skeuomorphic designs, as to create any UI it is essential for the designer to understand the cognitive models that a user brings to any new product (Hobbs, 2013). For example, if an object casts a shadow, our brains automatically visualise that as a 3D shape that has volume. These types of affordances are what skeuomorphic design gives to designers, which should be taken advantage of and mimicked in interface design (Sanchez, 2012).

On a smartphone, apps take up the entirety of the screen, which means you never display two apps next to one another. Thus, you can have two apps with very different visual styles without risking incoherence (Greif, 2013), allowing designers to create their own individual design style that lets their designs stand out in a very competitive market. It may also make the app feel intuitive to first-time users without having them read a manual or sit through a tutorial (Hollan, 2010). It is also a novelty user experience for the first-time users which creates a certain appeal and makes them want to use it and engages positive emotions in people (Downer, 2012). Skeuomorphism and realism may trigger strong connections with real-world designs. Although this may be seen as a strength of skeuomorphism sometimes, the association may be so strong that it will stop you from improving on what has already been done (Greif, 2013). Skeuomorphism, if done incorrectly, may morph into kitsch visual metaphors. But the real problem lies in the very concept and function of skeuomorphic interfaces, regardless of whether their appearance is realist or not. The problem is when borrowing features from the original design, you often also bring its limitations along for the ride, even when these limitations have no reason to exist anymore (Greif, 2013) which end up having a negative impact on the UI.

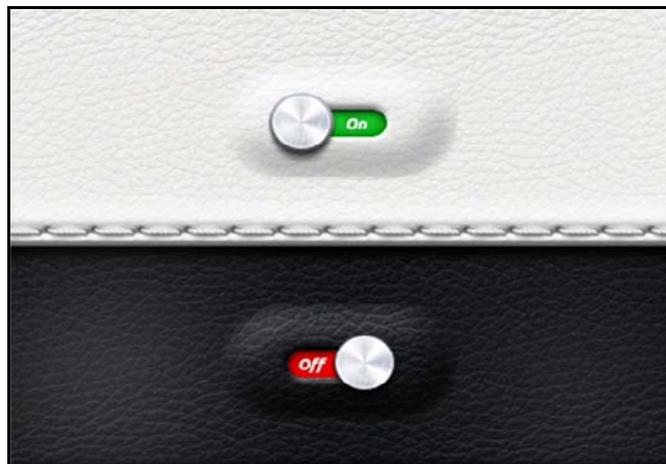
There is also the problem of getting skeuomorphism wrong: making something look like a physical object but not work like it. This can be seen in Apple's contacts app for the iPad, which like 'iBooks' uses the visual metaphor of a book with pages. But unlike 'iBooks', the 'contacts' app does not let you swipe left and right to flip pages, breaking the direct link to the book's metaphor and turning it into a purely aesthetical tool which removes the skeuomorphic design element. The use of a wooden thermometer can also be used as an example of bad skeuomorphism, because people presume that just because you are using a gaudy texture it must be skeuomorphism, when in fact because a real thermometer was made out of wood it was just a bad design and mixing of metaphors which is often done when designers use skeuomorphism without thinking and just implement it into a design even when it is not suitable (Greif, 2012b) see Figure 3.

Another consequence of skeuomorphism is that when merging real-life visuals with digital interactions, the 'model' starts to break. You end up with leather buttons, serif type on a lined notepad and false affordances like pages that cannot be turned. So as it tries to create familiarity to users, it can also create confusion and awkwardness (Sanchez, 2012). There are a few side affects to this surge of realism, which are being seen as bad uses of skeuomorphism. The real issue is when skeuomorphism turns into a trend it starts to be used for the wrong reasons, and designers just start using certain effects as a default tool to fall back on. Designing useful skeuomorphic UIs may be hard, but when done correctly it enhances the learning of the application and engages the user.

Skeuomorphism is like any other design technique and it can be misused. The excessive use by Apple and like-minded designers has created distaste for it among the web design community, thus resulting in the current skeuomorphism vs. flat design

debate. In essence, skeuomorphism is not all bad, but overusing its unnecessary ornamental visuals can be considered cliché and bad design choice. But using physics and 3D affordances makes it easier for us humans to interact with apps and thus designers should take advantage of them (Sanchez, 2012). Thanks to Apple, realism, often mislabelled as skeuomorphism, has been the dominant design paradigm of the last couple of years. But as designers get tired of fake leather and torn paper, more and more are gravitating towards a flatter, almost minimalist, aesthetic (Greif, 2012a) (see Figure 3).

Figure 3 An example of bad skeuomorphism use of gaudy textures (see online version for colours)



Recently, companies have sprouted up trying to predict the latest design trends, but all were shocked when the next design movement was spurred by Microsoft, distancing itself from skeuomorphism whilst emphasising a flat UI that is minimalist to the core (Carr, 2012). Whether to better differentiate themselves from Apple because they genuinely thought this was a better design, Microsoft embraced a completely different aesthetic (Greif, 2013). In opposition to the rise of skeuomorphism, the newly popular ‘flat design’, of which ‘Microsoft’s Metro UI’ is probably the main example, embraces visual minimalism, eschewing textures and lighting effects for simple shapes and flat colours (Figure 4).

Many designers have been calling the recent rise of flat design as a fad (Moore, 2013), due to the recent backlash against skeuomorphism. Much like not too long ago, designers working for the web were getting fed up with the irrational, ugly shortcuts being praised as good designs (Yu, 2012). Flat design is both popular and controversial in the world of UI (Moore, 2013). As there is a shift going on, design-wise, creating a movement away from faux textures perhaps epitomised by the texturally rich designs of iOS, Mac OSX. What is going on is more than just a rejection of over-the-top skeuomorphic textures; instead, it is a very strong push in the opposite direction (Gruber, 2013). Even game UIs comprise detailed textures and elaborate shadows are showing signs of embracing minimalism.

Figure 4 Microsoft's metro UI operating system (see online version for colours)

It can be argued that the trend of moving away from skeuomorphism and visual textural metaphors can be said to be happening due to the rise of the retina display (increased resolution). The timing of this trend and the fact that iOS, and the iPhone, in particular is its leading edge of smartphone design are not coincidental (Gruber, 2013). Retina displays are no longer limited in the way that requires the use of faux textures and effects to create beautiful UIs. The lack of skeuomorphic effects and almost extreme flatness of the 'modern' Windows 8 interface is remarkably forward thinking. It is meant to be viewed on retina-calibre displays not the sub-retina displays it was originally released on with Windows Phone 7.x or a standard desktop computer display. Although these new flat styles of interface design can be visually stunning, there seems to be a certain level of sterility to the design that prevents it from being endearing and thus lacks emotional connection with the user (Gruber, 2013).

The intensity with which flat design has been incorporated into UI designs came to light only after the market was already being saturated with faux skeuomorphic textures (Peters, 2013). It seems that designers were bored of the previous trend, which is why we have ended up with a design model that takes things in a completely opposite direction with no shadows, gradients or textures. It is key to note that flat design is used because it is the best design solution to the problem and not because the designer is just trying to be different (Greif, 2012a), which can often be the case when young designers are trying to distinguish themselves from their colleagues. If it were a graphic design trend, it would be well received, but web designers have to think about the usability of the design as well and not just the aesthetical side due to the direct connection between their work and the user; because user experience cannot be ignored, flat design is inherently flawed (Moore, 2013).

Flat design is based on the principle of completely stripping the interface of all the visual cues that we use to help us interact with our surroundings, and everything appears on a 2D plane. It is the affordances created by using skeuomorphism and the traits and qualities of a given object that help us identify what it is that we can do with it; for example, a knob affords twisting and a cord affords pulling. With reference to the metro UI shown in Figure 4, the uncomfortable lack of shadows, highlights and all-around spatial awareness may be noticed (Beshay, 2012). It is the removal of these affordances that helps create the minimalistic design aesthetic that flat design utilises, but taking this

new minimalistic approach too far can have serious consequences on usability (Beshay, 2012), because when all the affordances of the design are removed it is harder for the user to know how to interact with the interface. When everything is on the same plane, it is harder to focus on a specific section of the page (Greif, 2012a).

Over the recent years, user have come to rely on these affordances that skeuomorphic techniques create to guide their way through an interface; buttons have slight gradients and rounded corners. If you remove all of these clues, you end up with a flat design world where every element of the interface is suddenly placed on the same level, which can potentially lead to confusion (Rudberg, 2013). Vision is one of the most important senses we use and is a direct link to the world we interact with. It is usually our eyes that can detect whether a given object can be interacted with and how it can be interact with. Our eyes not only picks up colour, but can also detect light sources, degrees of shading and depth; these tools are what allow us to navigate complicated UI with the use of certain affordances (Beshay, 2012).

Perceiving flat design as a singular tool in one's bag of tricks is a dead end too. One should never have to choose between flat design and something else. Good designers do not sit down and decide to do 'flat design' one day and 'skeuomorphism' the next. Good designers design for context, utilising all that they have learned and forming a response that is uniquely their own, not the fan base's (Peters, 2013). When it comes down to the levels of user experience and usability, skeuomorphism and flat designs are disparate visual solutions, yes, but neither is a solution to the massive usability problem (Riley, 2013). The best solution usually lies somewhere in the middle. Compromise is hard for people with extreme opinions, which is usually the case when arguing the case for either Apple or Windows design, but it usually benefits the masses. In this case, the masses are the users of our products. There is a way to take all the good things from flat design and skeuomorphism/realism and apply them in a way that is still usable, even for highly complex interfaces (Moore, 2013).

With recent releases Google's new mobile apps, Google has started developing a style that some describe as 'almost flat' or maybe 'skeuominimalism', which can be seen in Figure 5. This new style uses elements like shadows and gradients in a tasteful, subtle way. Skeuominimalistic design is simplified to the point where simplification does not affect usability and its skeuomorphic affordances are maximised up to the point where it does not affect the simple beauty of minimalism (Sanchez, 2012).

Figure 5 Examples of new revamped Google applications across a group of platforms (see online version for colours)



For the most part, these interfaces adhere to the flat design principles of flat colours, no drop shadows and use of colour to encourage specific user actions. But it does not ignore the concept of depth and shadows entirely and allows the user the necessary affordances to operate the interface. Instead, depth is used to support comprehension of the interface. But just like gradients, this can be done in a subtle way and still allow for the separation of information (Moore, 2013).

3 Methodology

There were 274 respondents to the online questionnaire from Loughborough Design School. Several steps were taken in the design of the questionnaire to ensure responses were reliable and relevant. Open-ended questions were avoided to ensure the data would not become too obfuscated with periphery information. The questionnaire method was chosen instead of interviews due to the large and diverse sample size of the participants. Nevertheless, the questionnaire was a quantitative research method, as opposed to qualitative and, as such, the information gathered was not in as great a detail as that of an interview. It was also acknowledged that often the participants may not always answer everything truthfully, particularly if the question seeks to determine if the participant displayed signs of addiction. It is interesting that a large number of respondents advised that they completed the questionnaire via internet access from their smartphone, as opposed to their computer or tablet.

3.1 Reliability and validity of research methods

The online questionnaire was double-tested in a 'technical' manner and in the 'running' of the questionnaire as a whole. One of the primary criteria for the evaluation of this research tool is the demonstration of practical usefulness, including relevance, simplicity and ease of completion by the respondents. Lehtonen et al. (2007) devised a test based on the number of responses (response rate) to the questionnaire in relation to the total number of invitees. A weak response rate was deemed to show a response rate of less than 15%. A semi-strong response rate was one in the interval between 16% and 45%. Finally, a strong response rate was deemed to be the one with a response rate of 45% or above. This study fulfils the strong response rate as there were 274 responses from a total of 517 students invited to participate in the survey.

In this study, the research work underwent regular steering meetings where the research questions and the questionnaire were repeatedly reviewed and tested. A pilot was undertaken with 15 students in order to refine the questions and categorisation of responses. The objectives of the steering meetings were to specify research project targets and supervise the research progress. Furthermore, it decided on publication of the results achieved during the project.

4 Discussion of results

Although the results give a rough idea of what the respondents think about the topics discussed, it is now key that these results are analysed so that we can see if the aims of the research project have been fulfilled. Of the respondents that were included in the

questionnaire process, 174 were males and 102 were females. It was essential to know the gender of the respondent to ensure that the research was gender biased and that both male and female respondents had the same reaction to skeuomorphism in UI design throughout the results. It was found that gender did not play a role in distinguishing between the methods preferred by the designers.

With regard to the question *'Are you familiar with Skeuomorphism in designing user interfaces?'*, 82 respondents had a working familiarity with designing UIs with skeuomorphism. Of these 82 respondents, 60 were final-year students, which showed that in years one and two, there was a lack of knowledge around skeuomorphism and UI designs. It may be seen that the purpose of this paper is relevant as it is expected that it will be able to help young designers in expanding their knowledge of UI design and give them an improved perspective of the skill sets available to them to progress with.

With regard to the question *'After reading the information on Skeuomorphism and the rise of flat design do you feel there is still a place for Skeuomorphism in UI design?'*, 109 respondents, said 'yes' and the rest replied 'no'. This was a surprising result, as it was believed that more people would have said 'yes' to skeuomorphism. This shows that the student designers in general have a very minimalistic approach to UI design that lends itself to flat design. This goes hand in hand with the current design traits that can be seen in UI design with increasing number of young designers being influenced by visual aids that they find when researching design influence for a project and listening too much to the opinions voiced on internet design blogs.

With regard to the question *'If faced with a UI design task which design style would you use?'*, 96 respondents said 'skeuomorphism', 162 said 'flat design' and 16 said 'other'. Interestingly, the 96 respondents that said they would use skeuomorphism were from the group of 109 respondents that said they believe that there is a place for skeuomorphism in UI design. This may be because they are influenced by the Apple design software and follow them down the same design style, which is often the case with young designers as it showed that these people were in years one and two. The 162 respondents that replied 'flat design' are influenced by current trends and opinions of many designers on the web. The 16 respondents that replied 'other' were from the final year, showing that with age they have expanded their resources as a designer and are exploring other design ideas. This shows that age definitely is an important factor when it comes to being influenced by design seen on a day-to-day basis.

With regard to the question *'After reading the insert on skeuominimalism if you did not before, do you now feel that Skeuomorphism has a place in UI design as a complimentary instead of a standalone tool?'*, 188 respondents said 'Yes' and 86 said 'No'. It may be inferred that after viewing the passage on skeuominimalism many respondents changed their opinions on the topic from negative to positive. This shows that if the design tools are taught as a tool to help assist the design instead of a specific style in which to design, it can be much more beneficial to the designer and allow them to express their designs in the most appropriate way.

With regard to the question *'If you were now faced with a UI design task, which design tool would you use?'*, 18 respondents said 'Skeuomorphism', 42 said 'Flat Design', 214 said 'Skeuominimalism' and no one said 'Other'. It may be inferred that learning about skeuominimalism and using a combination of flat design in conjunction with skeuomorphism as design tools and applying them when relevant to their design have changed the opinion of the young designers that were questioned. It proves that some designers will stay true to the design styles they like, but the majority are interested in the tools that can produce the best design possible for the user.

With regard to the question *'After reading the research paper on Skeuomorphism and UI Design do you feel that it has improved your knowledge on this area of design and made you better equipped as a designer?'*, none of the respondents said 'strongly disagree', none said 'disagree', 42 said 'neutral', 98 said 'Agree' and 134 said 'Strongly Agree'. It may be inferred from this that the usefulness of skeuomorphism in UI design has proved to be very useful to the younger designers involved in the process who had access to the information on the topics discussed. Furthermore, 232 agreed that it has made them better equipped as designers and that more young designers should have access to this information on different design tools. It also reveals that instead of teaching specified design styles, which have to be adhered to, they should be taught as design tools which you can utilise when needed.

5 Conclusion

The first aim was to explore and discuss skeuomorphism and to determine its future in UI design. This aim was achieved through the rigorous research process that went into collating the information from a vast array of sources for the literature review. The questionnaire also allows young designers to express their opinions on the topic, which allowed the results to be analysed to show the worth of the academic report and how it could be used to influence designer's choices for the better. The second aim was to use flat design and skeuominimalism to give a wider perspective on the topic of skeuomorphism. This was achieved again through the use of the literature review which was then used as a tool during the questionnaire process to give additional information to the users before they can answer certain questions. The final aim of the research project was to help designers understand the areas of interface design and allow them to make a more informed decision when creating their own UIs. This can be said to have been achieved by the results shown in the questionnaire as [Question 8] asked *'After reading the research paper on skeuomorphism and UI design do you feel that it has improved your knowledge on this area of design and made you better equipped as a designer?'*. The results showed that 17 out of 20 respondents found the report useful and three found it neutral and did not have an opinion about the topic afterwards. This could be said to be a phenomenal success and has equipped the designers with better skills set to UI design.

This research has given account of the many areas and design tools available for UI design, looking at the widespread use of skeuomorphism and flat design with the upcoming rise of skeuominimalism. This study was set out to determine if skeuomorphism still had a place in UI design alongside the backlash of negative thoughts on the subject and increase of praise for flat design. It was also important that this project provided an insight into the topic for designers so that they could benefit from the research material gathered in devising content management systems to support mobile device learning.

This study has shown not only that the participants find the information provided useful and beneficial to them for developing further skills in design but also that when discussed at length and shown with visual aids, skeuomorphism does have a place in UI design but only through the use of skeuominimalism. The respondents stated that the majority of them would not use skeuominimalism as a stand-alone process to design with and would prefer to use the minimalistic approach of flat design. But when it comes to the idea of combining both skeuomorphic and minimalistic elements in conjunction with each other to get the best out of the design, many of them agreed that it could be very

useful and the majority of them would choose to use such a technique when designing their own UIs. This provides a methodology for the development of learning objects in mobile design education.

The results of this research support the idea that skeuomorphism does in fact have a place in UI design, but just not as a stand-alone feature but as one element of design. In general, it seems that the way in which these topics are being viewed is incorrect and is creating false opinions on the topic. This provides an enabling technology for developing tools and creating learning communities.

References

- Baranuik, C. (2012) *How we started calling visual metaphors “skeuomorphs” and why the debate over apple’s interface design is a mess*, 13 November. Available online at: <http://www.themachinestarts.com/read/2012-11-how-we-started-calling-visual-metaphors-skeuomorphs-why-apple-design-debate-mess> (accessed on 1 March 2013).
- Basalla, G. (1988) *The Evolution of Technology*, Cambridge University Press, Cambridge.
- Beshay, K. (2012) *Why I’m no metrosexual*, 12 March. Available online at: <http://kyrobeshay.com/post/37101801643/why-im-no-metrosexual> (accessed on 4 January 2013).
- Brajnik, G., Yesilada, Y. and Harper, S. (2011) ‘The expertise effect on web accessibility evaluation methods’, *Human-Computer Interaction*, Vol. 26, No. 3, pp.246–283.
- Carr, A. (2012) *Will Apple’s tacky software-design philosophy cause a revolt?* Available online at: <http://www.fastcodesign.com/1670760/will-apples-tacky-software-design-philosophy-cause-a-revolt> (accessed on 28 December 2012).
- Cyr, D., Head, M. and Larios, H. (2010) ‘Colour appeal in website design within and across cultures: a multi-method evaluation’, *International Journal of Human-Computer Studies*, Vol. 68, pp.1–21.
- Downer, C. (2012) *Skeuomorphism and the UI*, 22 November. Available online at: <http://realmacsoftware.com/blog/skeuomorphism-and-the-user-interface> (accessed on 24 February 2013).
- Durix, J-P. (1998) *Mimesis, Genres and Post-Colonial Discourse: Deconstructing Magic Realism*, 1st ed., St. Martin’s Press, New York.
- Greif, S. (2012a) *The flat sink*, 26 December. Available online at: <http://sachagreif.com/the-flat-sink/> (accessed on 7 January 2013).
- Greif, S. (2012b) *What skeuomorphism is (and isn’t)*. Available online at: <http://sachagreif.com/what-skeuomorphism-is-and-isnt/> (accessed on 12 September 2012).
- Greif, S. (2013) *Flat pixels: the battle between flat design & skeuomorphism*. Available online at: <http://sachagreif.com/flat-pixels/> (accessed on 12 March 2013).
- Gruber, J. (2013) *The trend against skeuomorphic textures and effects in UI design*. 18 January. Available online at: http://daringfireball.net/2013/01/the_trend_against_skeuomorphism (accessed on 18 January 2013).
- Hashimoto, A. and Clayton, M. (2009) *Visual Design Fundamentals: A Digital Approach*, Charles River Media, Newton Center, MA.
- Hobbs, T. (2013) *Can we please move past apples silly faux real UI’s*. Available online at: <http://www.fastcodesign.com/1669879/can-we-please-move-past-apples-silly-faux-real-uis> (accessed on 7 February 2013).
- Hollan, J.D. (2010) ‘Multiscale zooming interfaces: a brief personal perspective on the design of cognitively convivial interaction’, *Interactions*, Vol. 17, No. 6, pp.71–74.
- Hooten, E.R., Hayes, S.T. and Adams J.A. (2013) ‘Communicative modalities for mobile device interaction’, *International Journal of Human-Computer Studies*, Vol. 71, No. 10, pp.988–1002.

- Kelly, M. (1998) *Encyclopedia of Aesthetics*, Vol. 3, Kelly, M. (Ed.), Oxford University Press, London.
- Lehtonen, M., Page, T., Thorsteinsson, G. and Hepburn, M. (2007) 'An application of a virtual learning environment in support of teaching and learning for design and technology education', *International Journal of Learning Technology*, Vol. 3, No. 2, pp.133–151.
- Moore, M. (2013) *Almost flat design*, 23 January. Available online at: <http://www.matthewmooredesign.com/almost-flat-design/> (accessed on 5 February 2013).
- Norman, D. (1988) *The Design of Everyday Things*, Basic Books, New York.
- Odom, W., Blevis, E. and Stolterman, E.A. (2008) 'Personal inventories in the context of sustainability & interaction design', *ACM Interactions*, No. 5, pp.16–20.
- Peters, C. (2013) *Flatliners*. Available online at: <http://blog.colepeters.com/flatliners/> (accessed on January 23 2013).
- Riley, W. (2013) *Less aesthetic, more design*, 24 January. Available online at: <http://blog.wells.ee/less-aesthetic-more-design> (accessed on 24 February 2013).
- Rudberg, M. (2013) *Flat UI is not the only way forward*, 20 January. Available online at: <http://blog.maxrudberg.com/post/41005209081/flat-ui-is-not-the-only-way-forward>.
- Sanchez, E. (2012) *Skeuominimalism: the best of both worlds*, 15 October. Available online at: <http://edwardsanchez.me/blog/13568587> (accessed on 5 February 2013).
- Wulf, C. and Gebauer, G. (1995) *Mimesis: Culture, Art, Society*, 1st ed., Wulf, C. (Ed.), University of California Press, London.
- Yu, A. (2012) *The flat design era*, 25 September. Available online at: <http://layervault.tumblr.com/post/32267022219/flat-interface-design> (accessed on 3 January 2013).
- Ziefle, M. and Bay, S. (2006) 'How to overcome disorientation in mobile phone menus: a comparison of two different types of navigation aids', *Human-Computer Interaction*, Vol. 21, No. 4, pp.393–432.