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Title: THE DESIGN THINKING APPROACHES OF THREE DIFFERENT GROUPS OF DESIGNERS BASED ON SELF-REPORTS

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The design thinking approaches of three different groups of designers based on self-reports

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*Research Highlights

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Highlights

- Short design processes are not liner and skip conventional activities [73]
- Most students do not plan their design processes [48]
- Undergraduates opt to design physical objects; graduates prefer services/systems [81]
- All students spend a disproportionate percentage of time on final presentations [80]
- Design thinking advises teaching students to take risks, think outside the box [78]

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Abstract

This paper compares the design thinking approaches of three groups of student-designers: industrial design and architecture undergraduates, and design PhD candidates. Participants responded to an open-ended design brief, working individually. Upon submission of their designs they were debriefed about their design processes. We compare the groups based on their submissions and self-reported design activities, especially the sequence of their design activities and the time allotted to them. There were some commonalities and differences between the two undergraduate groups but the main differences were between the two undergraduates and the PhD students. On the basis of the findings we pose questions regarding design methods in the era of 'design thinking' wherein designers are required to adopt an entrepreneurial frame of mind.

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A lot of work has been published in recent years on the subject of design thinking and how designers think and work (Brown, 2009; Cross, 2011; Lawson, 2006; Lawson and Dorst, 2009). A frequently held consensus across those publications is the notion that design thinking has a number of common features, typified and manifest in a strong commitment and personal motivation of the individual. Moreover, it is widely suggested that designers possess courage to take risks, they are prepared to fail, and they work hard. Furthermore, during their design thinking activities designers regularly (re)define and/or frame the problem, they adopt holistic thinking, and they sketch, draw, and model possible ideas throughout the design process. Cross (2011) suggests there are three key strategic aspects of design thinking that appear to be common across a wide range of design disciplines, namely:

1. *"[Designers] take a broad 'systems approach' to the problem, rather than accepting* narrow problem criteria;
2. *[Designers] 'frame' the problem in a di*stinctive and sometimes rather personal way; and
3. *Designers design from 'first principles'."*

This paper sets out to examine the claim that despite individual and disciplinary differences, many aspects of design thinking are common across different design domains by comparing and contrasting the design thinking processes, methods and approaches of three different groups of designers – ID (Industrial Design students), ARCH (Architecture students), and DPHD (Design PhD candidates), with each group comprising four individuals. Table 1 highlights relevant background information of the participant design students. This information includes the participants' age, gender, year of study, and previous educational qualifications and experiences.

Table 1. Participants' background information

ID1	ID2	ID3	ID4
Male, 21 years of age, Industrial Design Student Year 3 of 4.	Male, 21 years of age, Industrial Design Student Year 3 of 4.	Male, 21 years of age, Industrial Design Student Year 3 of 4.	Male, 22 years of age, Industrial Design Student Year 3 of 4.
ARCH1	**ARCH2**	**ARCH3**	**ARCH4**
Male, 23 years of age, Architecture Student Year 5 of 5.	Male, 23 years of age, Architecture Student Year 5 of 5.	Male, 28 years of age, Architecture Student Year 5 of 5.	Male, 23 years of age, Architecture Student Year 5 of 5.
DPHD1	**DPHD2**	**DPHD3**	**DPHD4**
Female, 25 years of age, Year 1 of 3 year PhD, Bachelors degree in Fashion Design and Technology; Masters degree in Fashion Design.	Male, 27 years of age, Year 1 of 3 year PhD, Bachelors degree in Industrial Design; Masters degree in Industrial Design.	Male, 26 years of age, Year 1 of 3 year PhD, Bachelors degree in Industrial Design; Masters Degree in Design Innovation.	Male, 29 years of age, Year 1 of 3 year PhD, Bachelors degree in Industrial Design; Masters degree in Conceptual Design.

All twelve designers were given a short design brief and worked, individually and in their habitual environment, on a design proposal which, when ready, was submitted in the form of one or two presentation boards. They were also debriefed about their processes. Using their self-reports, the paper seeks to explore and examine any differences in the scope and nature of the designed "solutions" proposed by the three groups. Moreover, the paper examines the design processes of the three groups, studying how each individual designer planned his/her time, whether their design process was a linear activity or something else. The paper also quantifies the amount of time that each participant spent on particular activities including studying the brief, planning the design process, collecting information, looking at examples, consulting with others, thinking about solutions and sketching them, analyzing and comparing alternatives, evaluating interim and the final proposal(s), and preparing the final presentation.

We start by looking at the construal of the problem, which pertains to Cross' first and second aspects of design thinking. We then look at the design activities the participants pursued, which illuminates the principles that guide them. We look at the sequence of activities and the time allotted to each. We conclude with questions regarding the status of design methods in practice and education in an era in which designers are called upon to lead innovation at all times. The study is based on the participants' submitted designs and their self-reported attitudes, main focus points, and sequence and duration of design activities. While, in the past, self-reporting methods have been criticized for collecting data that has been either exaggerated by the respondent or respondents forgetting crucial details, self-report methods and techniques are a reliable, valid and applicable way of collecting information (Thornberry & Krohn, 2000). Methodologically similar to questionnaires and surveys, self-report methods are widely used in areas such as delinquent and criminal behavior research (Farrington et al., 1996), the usage of health care services (Bhandari & Wagner, 2006), and organizational behavior research (Spector, 1994) amongst many others.

1 Construing the problem

The design brief posed to the three groups of students (ID, ARCH, and DPHD) was very short and open-ended, and allowed for any number of problem-definitions and possible design responses. It read:

> 11% of the world's 6.9 billion people are over 60. By the year 2050 that figure will have doubled to 22%. If we are to support a growing number of older people we need to produce products, spaces, and services that allow them to stay healthy and well in and around their own home. You are asked to design a domestic product, living environment, or service for older people that surpasses conventional expectations.

It was therefore necessary to focus on an issue within the wide range of “domestic product, living environment, or service for older people that surpasses conventional expectations.” Each of the participants did so, alone or in dialogue with others: peers, teachers, or potential users. Once a need was identified the designer could frame the problem, that is, demarcate the initial design space (Schön, 1983), within which the problem is being explored and a solution is envisioned (Woodbury & Burrow, 2006). The term 'design space' pertains to a combination of a problem space and a solution space in the context of design, or, in Schön’s terms, the state space of possible designs. The task was construed within each designer’s design space, thus emphasizing aspects related very specifically to age-symptoms (which, as we know, are similar to disability symptoms that are not necessarily related to age) on one end of the spectrum, or having more to do with innovative products that may attract a range of users on the other end of the same spectrum. On the average all three groups rated the difficulty of the task as 3 on a scale of 1 to 5, which confirms that the brief was appropriate for this sample of designers.

Eight participants out of 12 who took part in this experiment chose to design products meant to support common daily activities and states of people with physical difficulties, discomfort, or those who cannot trust their memory (ID1, ID2, ID4, ARCH1, ARCH2, ARCH 3, ARCH4, DPHD1). Two designs proposed new services (DPHD3, DPHD4); one was a promotion and marketing idea for inclusive design (DPHD2) and finally, one project offered a simple interactive means to enhance safety by identifying knocks on the door as typical to specific visitors (ID3). Table 2 lists the various projects by the 12 participants.

It is not surprising that most participants chose to design products, but it is noteworthy that all architecture students, who could have been expected to concern themselves with ‘living environments’, designed consumer products; in fact living environments were not tackled by any of the participants. Most designs were relatively original – some less so (the least original was the cane that doubles as a device to pick up objects; such pickup devices exist, with a mechanism similar to the one proposed here).

Table 2. Choice of design task

ID1	ID2	ID3	ID4
Plate to make one confident when eating.	Bathroom aids (e.g. grips) that double as regular features.	Door knock records to identify who is at the door.	Day's activities planner as puzzle.
ARCH1	**ARCH2**	**ARCH3**	**ARCH4**
Cane that doubles as device to pick up fallen objects.	Umbrella handle arm support.	Tablet dispenser with clock.	Stay-warm thermal underwear.
DPHD1	**DPHD2**	**DPHD3**	**DPHD4**
Coats with built-in posture aiding memory foam to support sitting.	IDC – accreditation mark to recognize inclusive design.	Buddying correspondence scheme between elderly and orphans.	Internet-based service offerings by the elderly.

Legend

White	Product
Light grey	Safety
Medium grey	Promo
Dark grey	Service

When a problem is highly ill-defined, as in this case, deciding what the purpose of the design should be is an indispensable preliminary phase. In the case of this short exercise this meant choosing a context the designer was at least somewhat familiar with and that fits with his or her values. As put by DPHD1: "My main design goal was to fulfil the brief whilst incorporating aspects that were familiar to me", and by ARCH2, who said he wanted "*...to* make something that is useful". The availability of sufficient information within the short time frame of this assignment also played a role as it was not possible to thoroughly research a subject matter, build up knowledge and develop new competencies. This may explain the choice of products that were proposed as solutions to deficiencies in today's market (ARCH2 about his main design goals: "*...to design something that fills a gap in the market*"), all of which were related to known and well understood activities (e.g., better grip of an umbrella handle, pill dispenser with alarm clock) and states (e.g., discomfort due to cold environment, uncomfortable seating). All of the proposed products were conceived of as realistic commodities (ARCH4 about his main design goals: "*...to conceive of something that could* work in reality") and although most participants said they regretted not being able to test real prototypes and get feedback, their projects were presented as market-ready products that require just a little further development.

The scope of design has been widened in recent years and is no longer confined to products. The literature on design thinking stresses that design concerns itself with products, services and systems and in essence, it is a methodology to generate innovative ideas (e.g., Brown, 2009). Leading corporations and business schools adopted this approach and now see design as a prime vehicle for economic success. It is therefore surprising that only three of the proposals in our experiment approached design from a service or system perspective. One proposal called for a universal accreditation mark to recognize inclusive design. The universal design approach claims that all products should be designed such that they would be appropriate for all users, including people with disabilities or difficulties due to advanced age (e.g., Covington & Hannah, 1997). The rationale is that first, what the elderly or disabled can handle is comfortable for the rest of the population and second, that singling out the elderly and disabled by providing special and different products for them adds unnecessarily to their negative feelings of decline and isolation. For this reason, the design proposal by DPHD2 to tag products that have been tested for universality in terms of ease of use is a system design proposal that is most appropriate in the current context. There were two service proposals; one is internet-based, geared at posting services that elderly people may offer, particularly in their communities. The other service suggests a correspondence scheme between the elderly and orphan children, for the benefit of both parties. Both services are in line with the predominant expanded view of design as expressed in literature on design thinking. We shall return to the issue of design thinking later in this paper.

2 Design activities and sequences

After completing their design projects, participants were presented with a list of nine design activities (in random order) and asked to indicate which of these activities they were engaged with and for how long. Table 3 shows the number of participants who reported being engaged in each design activity (in this table and in subsequent tables and figures, the sequence of activities follows standard prescribed design methods, but this is not the order in which the activities were presented to the participants).

Obviously, all participants studied the brief and all of them prepared a final presentation (required). The only other activity that they all engaged in, according to the reports, was 'thinking about solutions and sketching them'. However, other activities were not as universally practiced. Two participants did not look at examples; three participants did not consult with others. The same number of participants was not engaged in 'analyzing/comparing alternatives'. Four participants reported not collecting information beyond the givens in the brief (which were quite scant). Five participants – almost half – did not evaluate their designs, either along the design process or at its conclusion. Less than half the participants reported having planned their design processes. The distribution of 'planners' was particularly interesting: none of the architecture students, and only one industrial design student, planned their process. One of the architecture students (ARCH2) explained: "Because of the compressed nature of the task I didn't really plan the design process, all the stages tended to be compressed." In contrast, all of the graduate design students found it necessary to plan their processes, which may mean that they used a conscious strategy in the design process. We shall comment about the differences among the various designer categories and their behaviors as reflected in this experiment later in the paper.

We held a structured debriefing interview with each participant after he or she completed the design. Regarding the design activities, participants were asked to indicate the order in which they undertook them as well as the amount of time dedicated to each activity. We shall discuss the time allocation in the next section; here we would like to review the activity sequences. Figures 1, 2 and 3 show this sequence for each participant within the relevant designer category. The straight diagonal line in each of the figures represents a theoretical linear process, in which activities are undertaken in the order in which they appear at the bottom of the Figure, from left to right. This order is, as mentioned earlier, more or less a 'textbook sequence' as prescribed in various design methods handbooks (e.g. Roozenburg & Eekels, 1995). As Figures 1 to 3 show, the process followed by our participants did not mirror the recommended methods. We must qualify this assertion: when asked whether their process was linear, most participants said it was not. Moreover, many of them said they went back and forth between two or three activities, something we could not account for in the Figures below.

Table 3. Number of designers engaged in activities (max. 4 in each designer category and 12 in total)

	Studying the brief	Planning the design process	Collecting information	Looking at examples	Consulting with others	Thinking about solutions and sketching them	Analyzing/comparing alternatives	Evaluating interim and the final proposal(s)	Preparing the final presentation
ID	4	1	1	2	3	4	3	2	4
ARCH	4	0	4	4	3	4	2	2	4
DPHD	4	4	3	4	3	4	4	3	4
Total	**12**	**5**	8	10	9	**12**	9	7	**12**

The main deviation from the classic model concerns the stage at which participants chose to augment their knowledge or solicit other opinions. Thus collecting information, looking at examples or consulting with others occurred, at various points in time, usually after ‘thinking about solutions and sketching them’. Those who reported undertaking analysis of alternatives did so after ‘thinking and sketching’. In conventional design process models analysis occurs before a solution is sketched. Here, however, analysis refers to proposals that have already been generated, and therefore it is sensible to engage in it after having done at least some thinking about solutions and sketching them. Analysis that occurs late in the process may reflect a process dominated by trial and error.

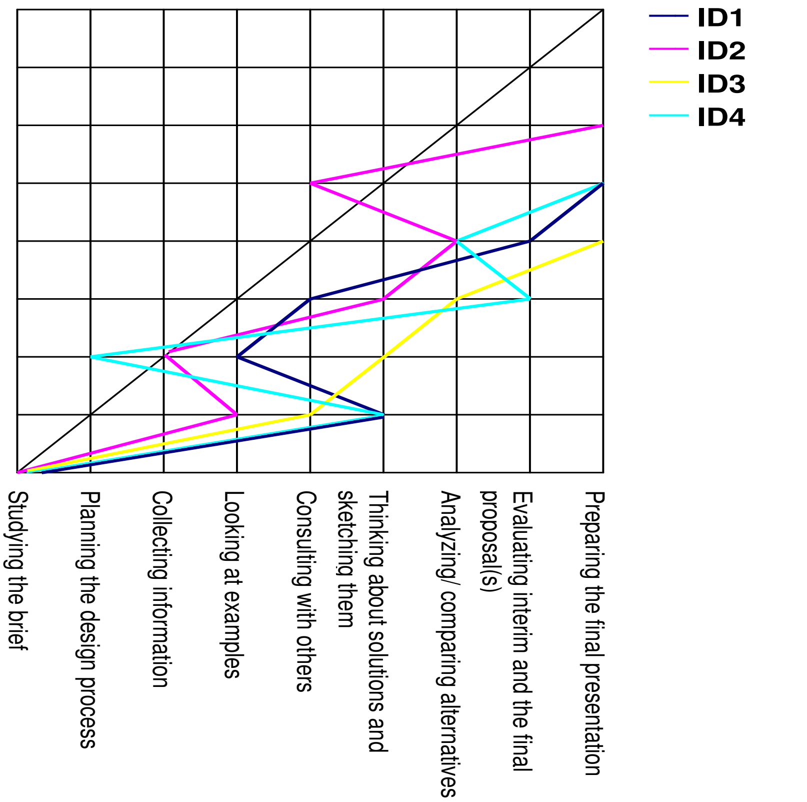

Figure 1. Activity sequence, Industrial Design students

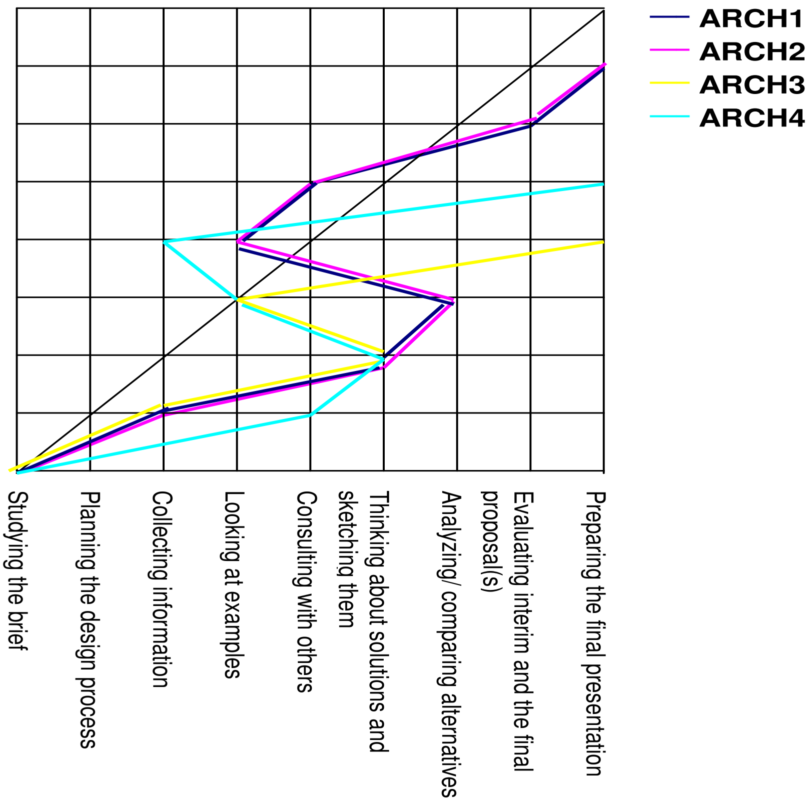

Figure 2. Activity sequence, Architecture students

It is particularly interesting to learn when planning of the process took place, when it did (as mentioned earlier, only five participants planned their processes). One would expect this to happen early in the process, but this was not always the case. In one case planning was undertaken only after thinking and sketching (ID4) and in two other cases it was reported to occur rather late, and after intensive information handling (DPHD1, DPHD2). It is also interesting to notice that in two cases the design process did not commence with studying the brief; in one case the participant started thinking and sketching and only then went back to the brief to study it (DPHD4). In the other case the designer consulted with others first and only then resorted to the brief (DPHD2).

Clearly, in such a compressed process, wherein the problem was critically ill-defined, we cannot expect 'textbook' processes. All the same, the diversity revealed in this experiment raises useful questions about the status of a prescribed design method and the consequences of not observing an orderly convention. There is plenty of evidence that designers consciously ignore methods they were taught at school (e.g., Goldschmidt, 2008) and the question then is: what should be taught? We shall return to this issue later in the concluding section of the paper.

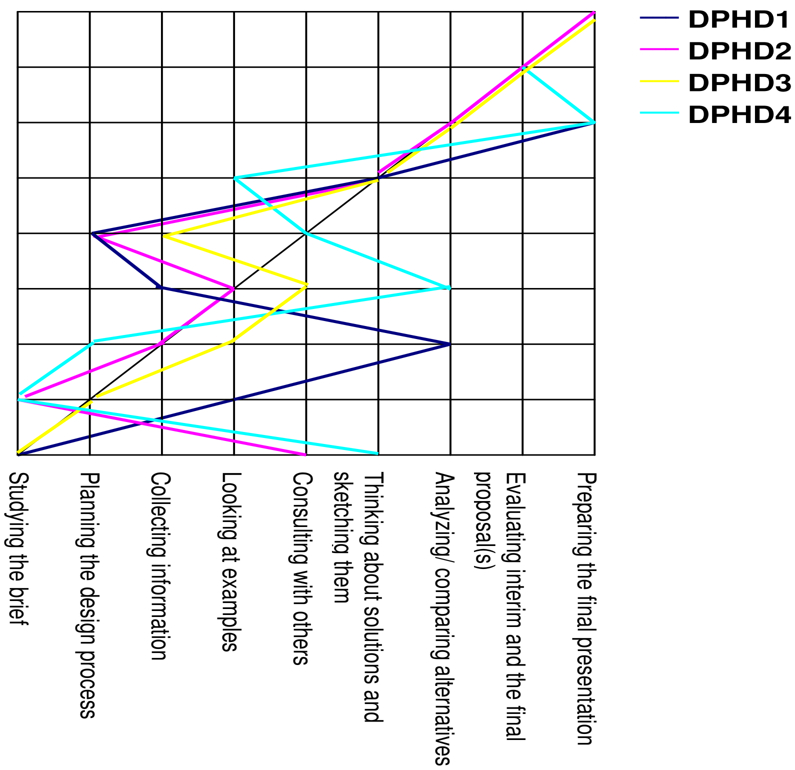

Figure 3. Activity sequence, Design PhD students

3 Time allocation

As in the sequence of design activities, we notice considerable individual differences among participants in the time they devoted to the various activities. The overall design time ranged from a minimum of 153 minutes (DPHD4) to a maximum of 900 minutes (ID4), with an average of 603 minutes for the ID participants (or 503 minutes, if we ignore ID4 who devoted an outstanding amount of time to the production of a working prototype of his puzzle design), 326 minutes for the ARCH participants, and 357 minutes for the DPHD participants. Figure 4 is an overview of the mean percentage of time devoted to activities, by design category.

The figure reveals a few interesting differences among the three constituencies of participants. First, we cannot fail to notice how much time was devoted to preparing a final presentation – 32.1% in the case of ARCH participants, and 24.7% by both ID and DPHD participants. The undergraduate students devoted a lot of time to thinking about solutions and sketching them, 31.8% for IDs, and 29.6% for the ARCH students. The graduate students, DPHD, allocated only 18.1% of their time to this activity. Another interesting observation is that whereas the DPHD participants devoted approximately 10% of their time to each of the three information summoning activities, the two other groups showed different patterns. The ID students devoted about 6% to both collecting information and looking at examples and spent more than double the time – 13.5% - consulting with others. The ARCH students spent very little time consulting with others, only 3.9%, but in revenge they dedicated 9.4% and 13.8%, respectively, to looking at examples and collecting information. The overall percentage of time dedicated to the three activities is, however, quite similar for the three groups: 25.7% for ID participants, 27.1 for ARCH participants, and 30.7% for DPHD participants.

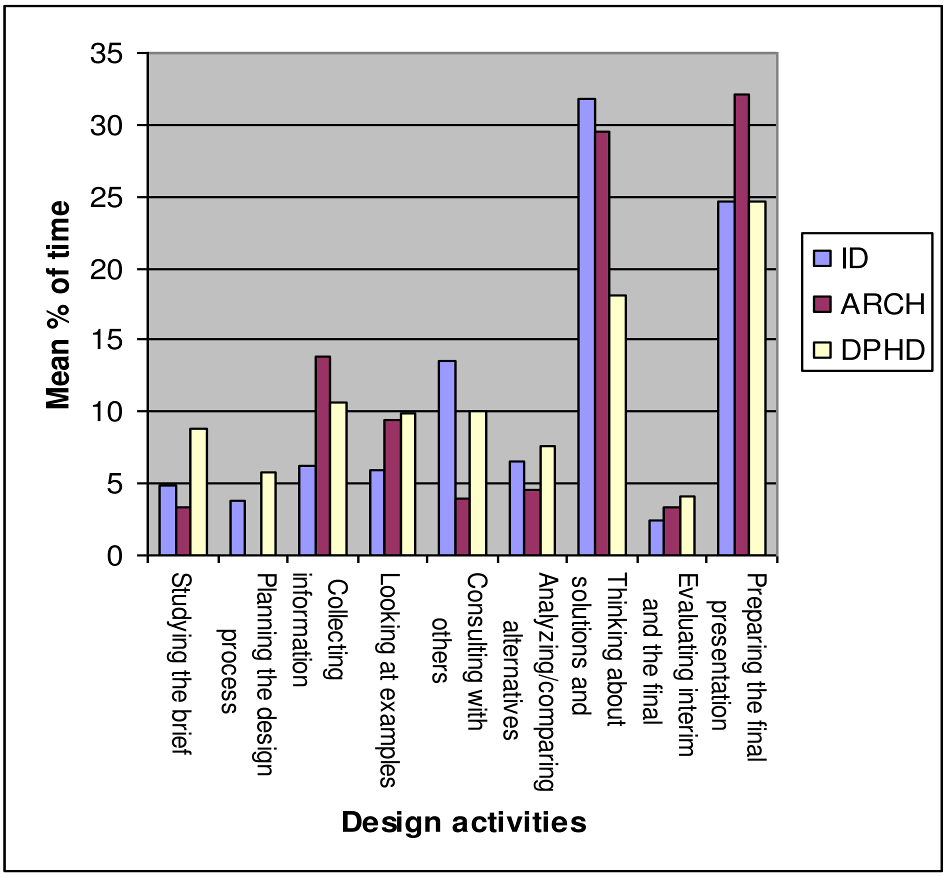

Figure 4. Mean percentage of time devoted to activities

Other interesting differences among the groups are that the DPHD students spent about twice the amount of time studying the brief than the other groups and, as mentioned earlier and evident here, the ARCH participants spent no time at all planning the design process. On the similarities side is the very minimal time devoted to evaluating interim and final designs by all groups, already mentioned.

We must qualify these observations not only because of the small number of participants, but also because of the significant individual differences among students in each of the groups. If we look at but a few examples in the activities that everyone undertook, we find, for instance, that the percentage of time devoted to preparing the final presentation among ID participants ranged form 4.5 to 46 percent. Studying the brief ranged from 5 to 12.5 percent among DPHD participants, and among the ARCH participants, thinking about solutions and sketching them, ranged between 18.3 and 36.8 percent. Despite these qualifications we believe that with due caution, we may all the same conclude that some trends that distinguish among the groups do exist, and we discuss them in the next section.

Figures 5, 6 and 7 combine the activity sequences and percent of time spent for each participant within the three groups.

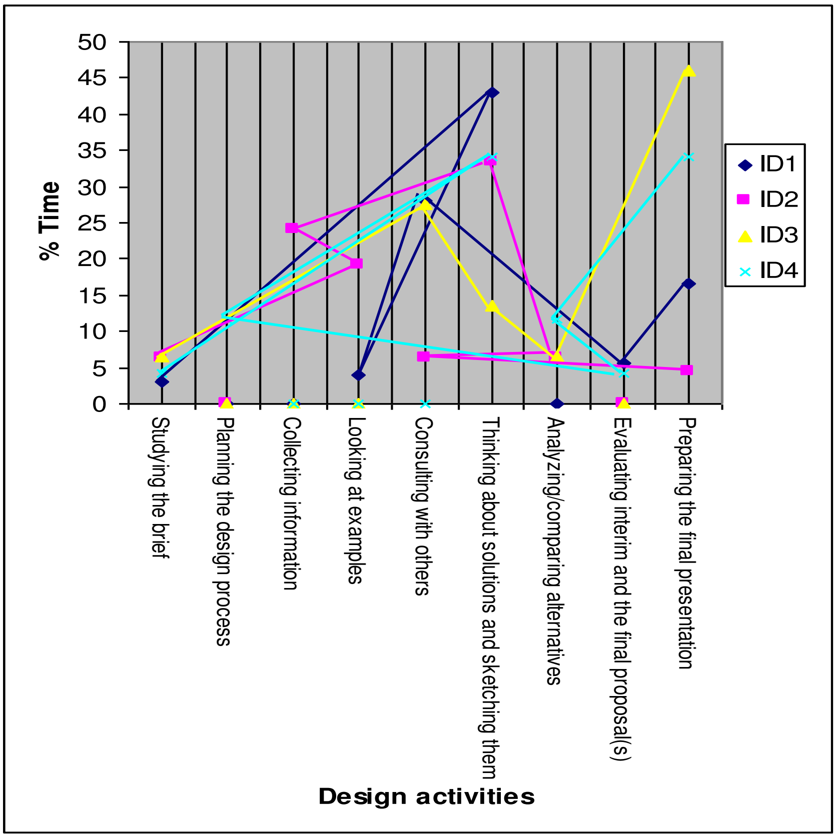

Figure 5. ID students – chronological sequence of activities and percentage of time spent

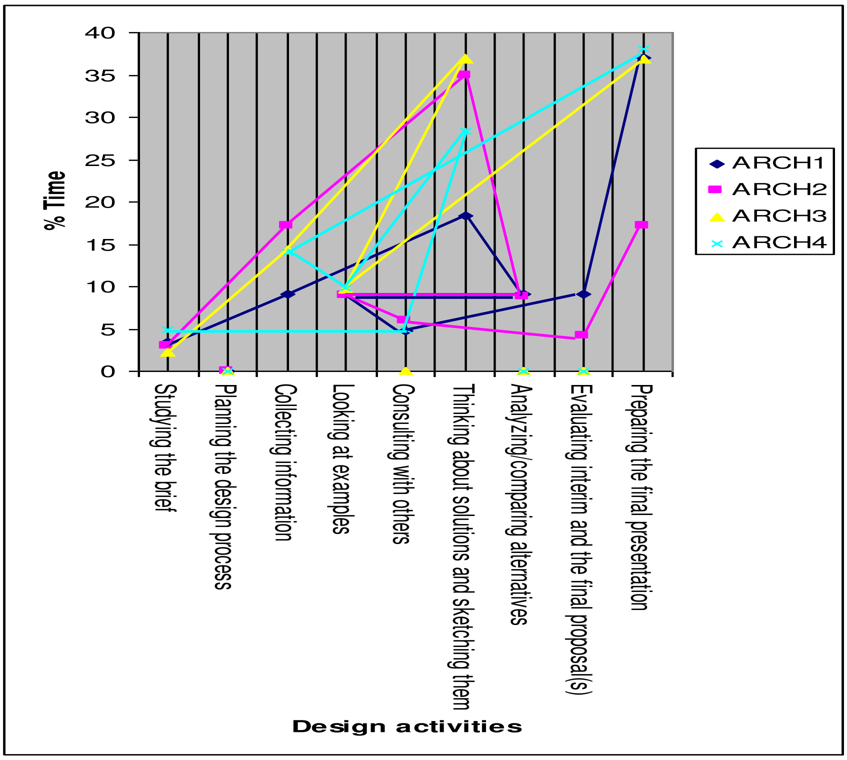

Figure 6. ARCH students – chronological sequence of activities and percentage of time spent

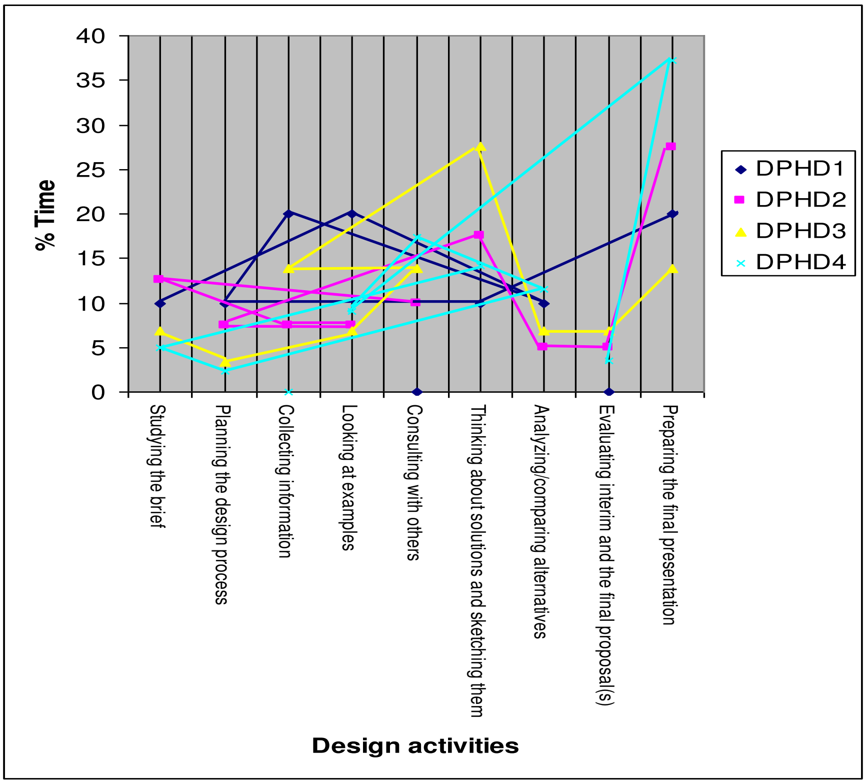

Figure 7. DPHD students – chronological sequence of activities and percentage of time spent

4 Undergraduate versus graduate students

Despite the small size of the sample and the individual differences among members within the groups, it seems to us that some interesting distinctions among the groups suggest themselves.

We already indicated some differences between the ID and ARCH participants and most noticeably, divergence in their information sources, and some more attention to the final presentation on the part of the ARCH participants. However, we find that the more significant differences are between the two groups of undergraduate students, ID and ARCH, and the group of graduate students, DPHD. We pointed out the differences in subject matters – tangible objects for all undergraduate students, and mostly services and a system in the case of the graduate students. In terms of design behavior – in our case time allocation and activity sequences – we have already mentioned the fact that DPHD participants paid more attention to the brief, and all of them planned their processes, versus only one undergraduate participant who did so. Planning the process ahead may signify that a particular strategy was employed. This is in line with the finding by Ahmed et al. (2003) that experienced designers use particular design strategies, as opposed to novices who tend to display a trial and error behavior pattern. The graduate group tended to use all channels of information uniformly, in contrast to the undergraduate participants. In addition, the graduate participants engaged in more design activities (average of 8.25 out of 9) than the undergraduate participants (average of 6.0 and 6.75 for the ID and ARCH groups, respectively).

Undergraduate participants started the process with a short study of the brief; then most of them engaged in one information soliciting activity, followed by thinking about solutions and sketching them. With one exception of a participant who started the process with the thinking and sketching activity (DPHD4) all graduate participants deferred it and preferred to first summon information in various ways, plan their processes and engage in a few other activities. Table 4 shows the chronological stage at which the thinking and sketching activity was undertaken (out of 9 possible activities). The difference in chronological order is of course related to the total number of activities which, as stated, is significantly higher for the DPHD group.

Table 4. Chronological order of the a*ctivity "Thinking about* solutions and sketching t*hem"*

Undergraduate students (mean: 6.4 activities)								Graduate students (mean: 8.3 activities)			
Industrial Design				**Architecture**				**PhD in Design**			
ID1	ID2	ID3	ID4	ARCH1	ARCH2	ARCH3	ARCH4	DPHD1	DPHD2	DPHD3	DPHD4
2	4	3	2	3	3	3	3	6	6	6	1

The difference is most telling. The more experienced graduate students are probably also more research-minded and display a more systematic design behavior. All of them engaged in analysis, whereas only a little over half the undergraduate students did so (see Table 3). Deferring decisions regarding solutions is in line with creative problem solving (e.g., Goel, 1995; Treffinger et al., 2006), although it would have made sense to generate candidate solutions or at least partial candidate solutions earlier in the process. Because of the reported iterations and the going back and forth that participants experienced, partial solutions may have been generated in fact, but it is interesting that these relatively experienced participants chose nonetheless to report that they engaged in this activity only later on. Interestingly, DPHD4, who was an exception and started the process with thinking and sketching, reported that his process was "quite linear" and added: "I considered a few options then just went for one. I didn't reconsider my idea."

Is this difference in design behavior a result of the relative expertise of the DPHD participants, compared to the ID and ARCH participants who are still novices? Or does it have to do with the fact that having chosen to pursue an advanced degree, the DPHD participants belong a priori to a self-selected category of research-oriented designers who naturally approach design problems more methodically? It is hard to tell, and the answer may not be 'either or' but rather both: experience combined with a methodical disposition makes it possible for these participants to tackle an open-ended, ill-defined problem with routines they have already mastered earlier. Our results concur with several other researchers' work where comparisons have been made between 'novice' and 'expert' designers and the superior efficacy of the expert designers' design activities over their novice counterparts was demonstrated (Adams et al, 2003; Ahmed et al, 2003; Atman et al, 2005; Popovic, 2003).

The novices, in contrast, have fewer fixed routines and probably work more intuitively, especially when the problem is unusually open-ended and compressed, something they are not used to. As ARCH2 confided: "The design process that we follow in architecture [school] is usually set for us by weekly sheets that accompany tutorials and working towards stage reviews". Therefore, it seems, novices need to sketch earlier. The fact that most DPHD participants proposed services or a system rather than a tangible object had seemingly no effect on the displayed design behavior (although it may explain the significantly lower percentage of time devoted to thinking and sketching, as no details had to be worked out). Services and systems need thinking about of course, if not necessarily sketching; and DPHD4, who started with 'thinking and sketching', was one of the service proposers. We definitely notice a different approach and pattern in the design behavior of the two constituencies, novice and relative experts, which is very interesting and may have consequences for design education.

5 Design thinking: The designer-entrepreneur

Our main findings in the limited experiment we have conducted are summarized as follows: Undergraduate students responded to the brief by proposing a physical object (product) regardless of their course of study. Most participants did not plan their processes or did so to a very limited extent. Most of them did not follow a linear process: they went back and forth and iterated a lot between one activity and another. On average, between a quarter and a third of the participants' time was devoted to the preparation of a final presentation. Both sets of undergraduate design students (ID and ARCH) spent an average of close to one third of their time on "thinking about solutions and sketching them." The DPHD students spent far less time on this activity – possibly because, for the most part, they did not design physical objects but services or systems, which may have required fewer problem-solving cycles. Alternatively, this finding may be attributed to the DPHD students' superior design experience and knowledge. Finally, and perhaps unsurprisingly, the most important source in collecting information for all students was the Internet. The ARCH students spent twice the amount of time as the ID students searching the web for information. However, the ID students consulted with others more than three times as much as the ARCH students.

These findings converge to show that in open-ended design tasks and under time constraints, methodological prescriptions should be eased. The great variety in design behavior parameters we have found leads us to some very general conclusions pertaining to design and design education, which we take to be fundamentally significant to the wider and more entrepreneurial scope of design in the era of design thinking.

The design time in this experiment was short: up to 15 hours (and as little as 2.5 hours in one case; the average was a little over 7 hours) and most students saw the assignment as "compressed" and atypical. ARCH4 said: "One-off exercises like this are rare." But should such exercises be rare? The boundaries of what is included in design practice have expanded considerably in recent years to include a wide range of consultancies, organizations and companies that seek to innovate in many ways. Now design extends from the design of objects and spaces that we use on a daily basis to cities, landscapes, nations, cultures, bodies, genes, political systems, the way we produce food, to the way we travel, and build cars (Latour, 2008). Moreover, with accelerated design activity anticipated well into the 21st century it is clear that an increasing number of practitioners across a diverse range of creative disciplines routinely regard their methods as rooted in design practice or are using methods that could be considered designerly (Cross, 2006). It is also equally clear that design is expanding its disciplinary, conceptual, theoretical, and methodological frameworks to encompass ever-wider activities and practice. The way designers think, it is claimed, is conducive to innovative solutions (Brown 2009**;** Martin**,** 2009; Nussbaum, 2009). Certain design communities and quite a range of business communities are adopting the so called design thinking method to enhance innovation in enterprises of various kinds, which consider it to be the most contributory factor to a competitive advantage. The term design thinking is in good currency in both academia and among practitioners and has produced a host of recent publications (e.g., Brown, 2009; Cross, 2011; Lockwood, 2009; Martin, 2009; Verganti, 2009). There is no agreed upon definition of 'design thinking', but the strongest common denominator is the centrality of the user, or even, in the view of some, being "empathic to the human condition"[1] (other features of design thinking such as iterative exploration, prototyping and teamwork are irrelevant to the current 'compressed' case).

Design thinkers are expected to constantly challenge the boundaries of known solutions and venture to unchartered territories. Their processes are expected to be systematic but not rigid and flexibility of thought and exploration are key concepts. The designer, it seems, is expected to demonstrate an entrepreneurial approach, even when the task is initiated by someone else (client). In addition, designers must work fast as competition in the marketplace drives short design cycles. "One-off", compressed assignments are very realistic occurrences in practice. Does design education address these challenges?

If indeed we subscribe to the notion that design thinking is a key to innovation which, in turn, is the fuel that turns the wheels of economy, then we must ask: how should we educate design thinkers? What methodologies should they learn, what design processes do we want to encourage? Textbook methods (e.g., Birkenhofer, 2011; Pahl and Beitz, 1984; Roozenburg and Eckels, 1995; Ullman, 1992/2003) are on the rigid side. They foresee a linear process, albeit with iterations. They are tacitly based on the assumption that at the time the problem solving or design process starts, the task has been sufficiently clarified and the problem is more or less well-defined, even well-structured. They have a hard time seeing a problem and a solution being co-developed (Dorst & Cross, 2001), as we know is very often the case in

[1] Alison King, email to the DesignX community, Center for Design Research at Stanford University, April 19, 2011.

design, particularly when innovation is the goal and the problem definition may be revised or at least negotiated at almost any stage.

Do the design methods we teach our students prepare them to handle ill-defined and ill-structured problems, even wicked problems, wherein innovation is a prime goal and the pace is very fast? Do we teach them adequately to take risks? to be original and think ‘outside of the box’? Do we ask them to go to extremes and explore entirely new directions of thought, as is often required today? The modest task in this experiment called for a design that "surpasses conventional expectations". Did the student-participants rise to the challenge, and what in the processes they underwent supported or hindered success? Trying to follow a linear process was not necessarily advantageous. Interestingly, the two developers of new services, both DPHD students who were, appropriately, aware of the expanded scope of design, reported 'quite linear' and 'more or less linear' processes. So did some of the designers of the less original designs in the ID and ARCH groups. Those who took the liberty to go back and forth had somewhat more opportunities to experiment and explore, and finally embarked upon somewhat more original design ideas. Extremely ill-defined problems and tight design schedules are excellent opportunities to think differently, to bypass or revise standard methods, and therefore it is highly recommended that they do not continue to be a rare exception in design education.

It seems that we should encourage our students to devote more time and effort to explorations, and certainly not focus so much attention on preparing final presentations (especially in very compressed exercises). Should we teach methods? We definitely should, but it must be emphasized that normative methods are to serve as general guidelines, check lists perhaps, rather than rigid prescriptions, and the order in which activities are undertaken is often flexible and context-related. It is reassuring that even a most limited experiment of the kind we have conducted allows us to reach a conclusion of such magnitude. If we want designers to merit the credit they are given today even outside of the world of design as strategic players in the forefront of innovative initiatives, we should prepare them accordingly. The world is ready to acknowledge the artistry of design, not just the 'science' of design, as advocated by Donald Schön decades ago (1983). But are designers and design educators ready to let go of an adherence to rigid 'methods'? Learning to do so is one of the challenges facing design education as well as practice.

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The design thinking approaches of three different groups of designers based on self-reports

Gabriela Goldschmidt and Paul A. Rodgers

Figures, with captions (7 Figures)

Please note: In print Figures should be grey scale.

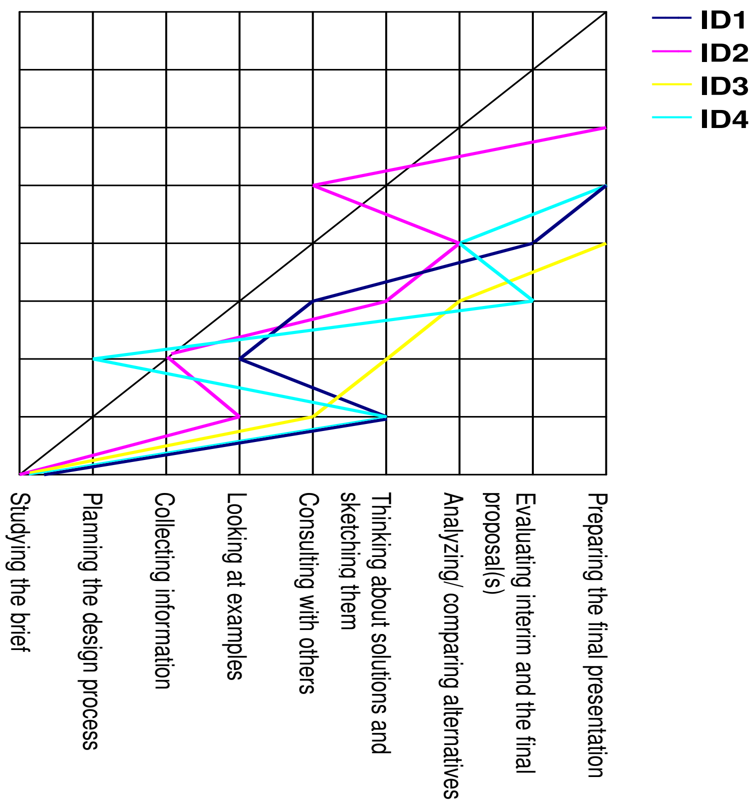

Figure 1. Activity sequence, Industrial Design students

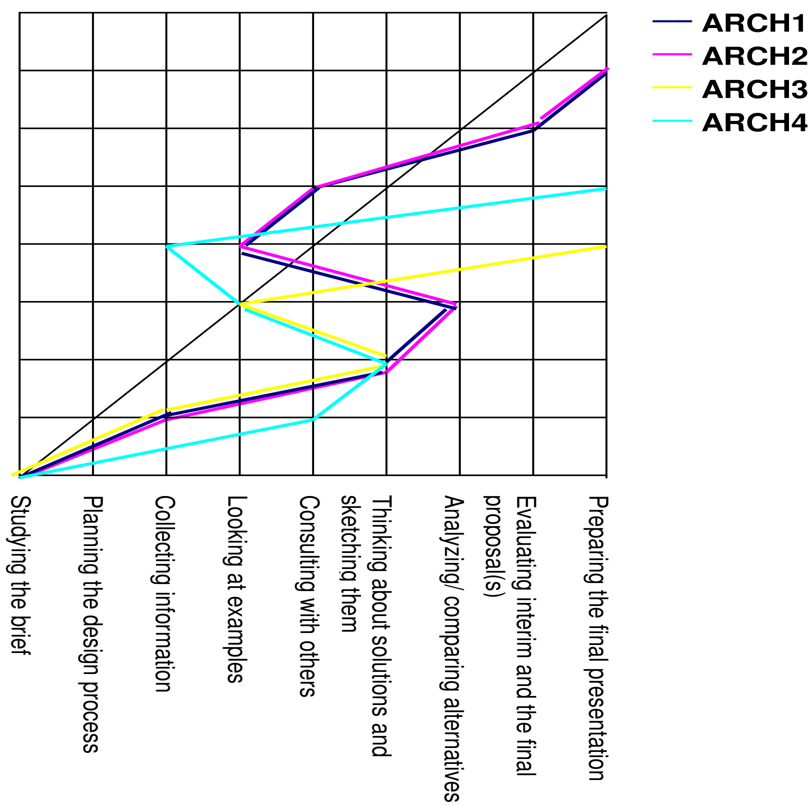

Figure 2. Activity sequence, Architecture students

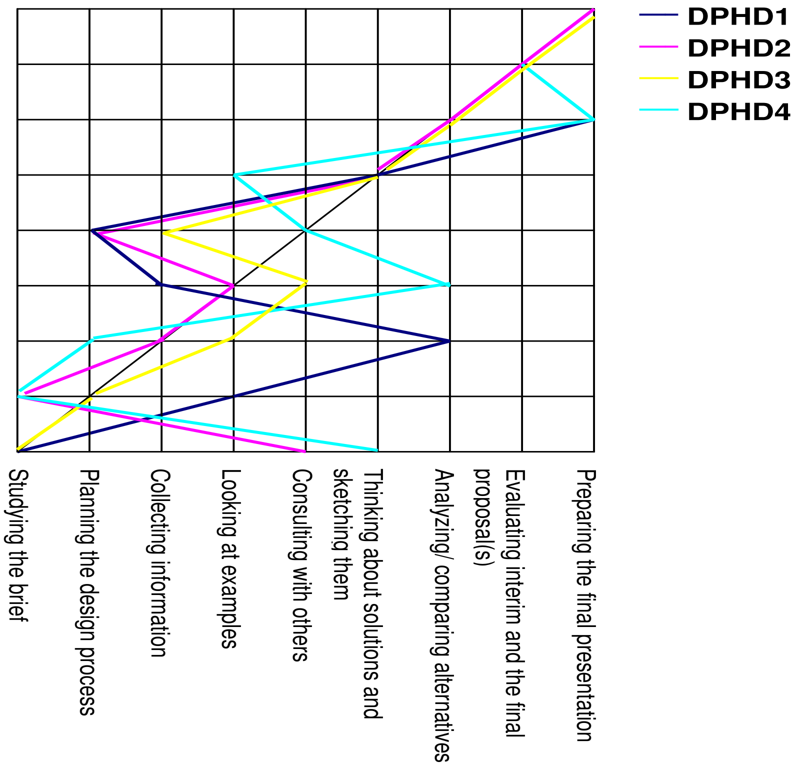

Figure 3. Activity sequence, Design PhD students

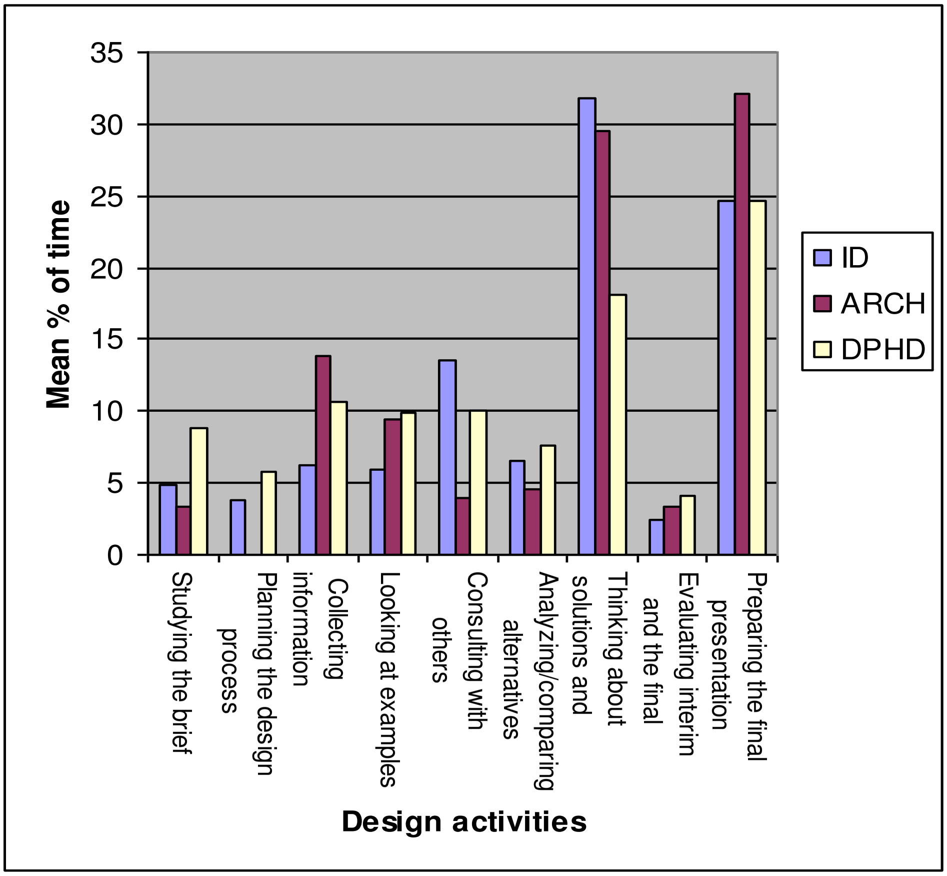

Figure 4. Mean percentage of time devoted to activities

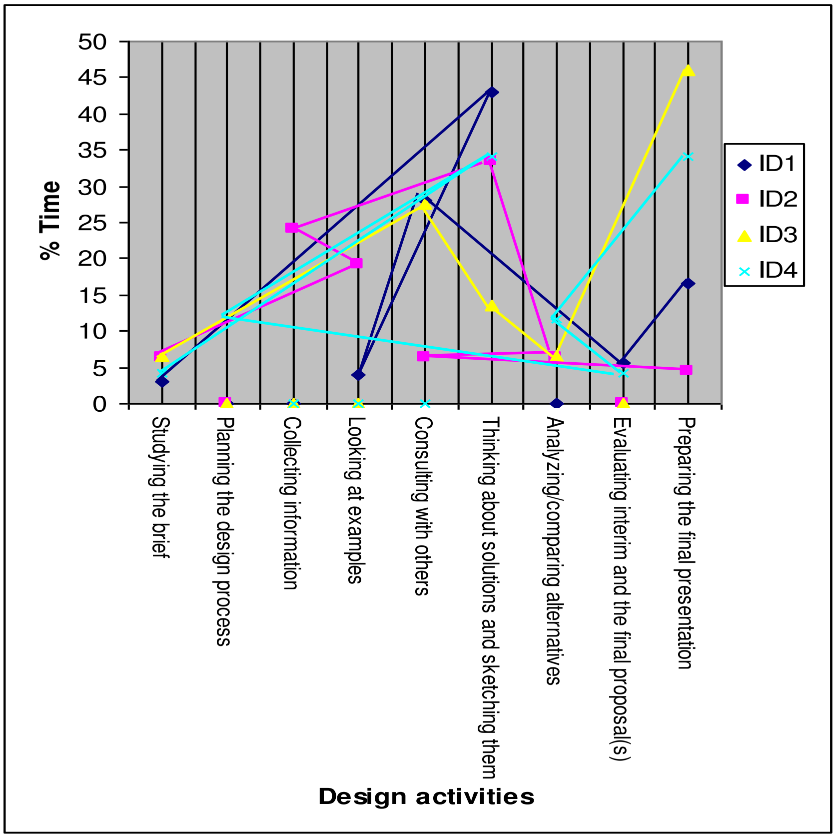

Figure 5. ID students – chronological sequence of activities and percentage of time spent

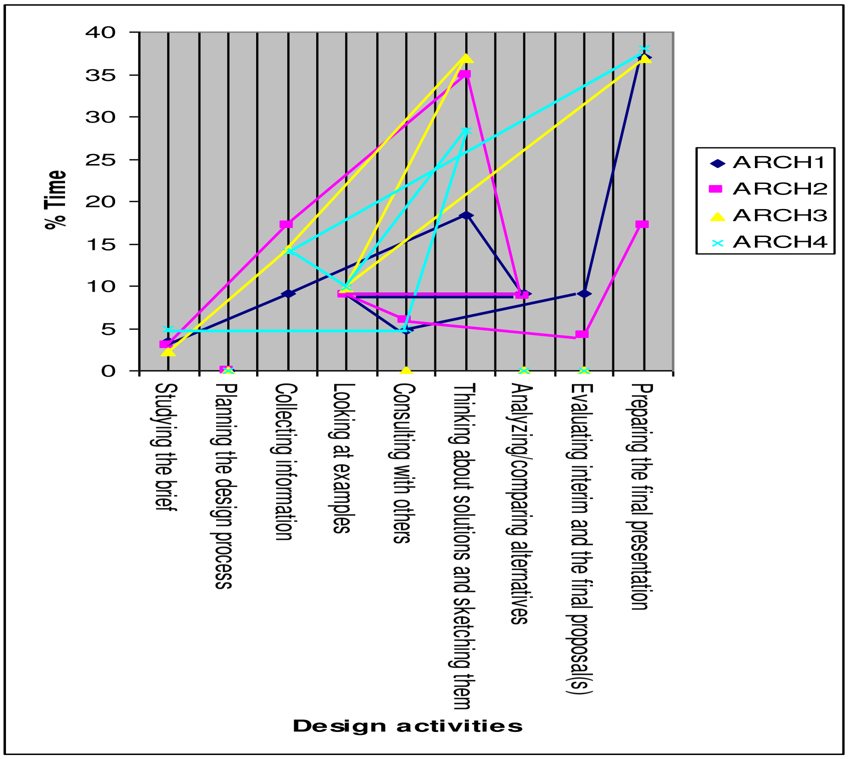

Figure 6. ARCH students – chronological sequence of activities and percentage of time spent

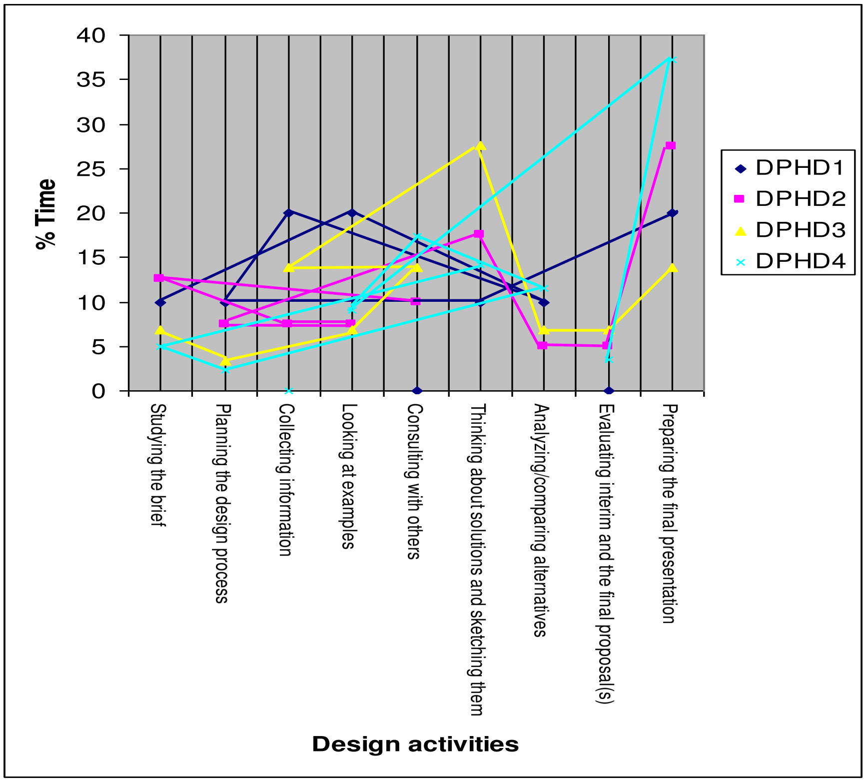

Figure 7. DPHD students – chronological sequence of activities and percentage of time spent

The design thinking approaches of three different groups of designers based on self-reports

Gabriela Goldschmidt and Paul A. Rodgers

Tables, with titles (4 Tables)

Table 1. Participants' background information

ID1	ID2	ID3	ID4
Male, 21 years of age, Industrial Design Student Year 3 of 4.	Male, 21 years of age, Industrial Design Student Year 3 of 4.	Male, 21 years of age, Industrial Design Student Year 3 of 4.	Male, 22 years of age, Industrial Design Student Year 3 of 4.
ARCH1	**ARCH2**	**ARCH3**	**ARCH4**
Male, 23 years of age, Architecture Student Year 5 of 5.	Male, 23 years of age, Architecture Student Year 5 of 5.	Male, 28 years of age, Architecture Student Year 5 of 5.	Male, 23 years of age, Architecture Student Year 5 of 5.
DPHD1	**DPHD2**	**DPHD3**	**DPHD4**
Female, 25 years of age, Year 1 of 3 year PhD, Bachelors degree in Fashion Design and Technology; Masters degree in Fashion Design.	Male, 27 years of age, Year 1 of 3 year PhD, Bachelors degree in Industrial Design; Masters degree in Industrial Design.	Male, 26 years of age, Year 1 of 3 year PhD, Bachelors degree in Industrial Design; Masters Degree in Design Innovation.	Male, 29 years of age, Year 1 of 3 year PhD, Bachelors degree in Industrial Design; Masters degree in Conceptual Design.

Table 2. Choice of design task

ID1	ID2	ID3	ID4
Plate to make one confident when eating.	Bathroom aids (e.g. grips) that double as regular features.	Door knock records to identify who is at the door.	Day's activities planner as puzzle.
ARCH1	**ARCH2**	**ARCH3**	**ARCH4**
Cane that doubles as device to pick up fallen objects.	Umbrella handle arm support.	Tablet dispenser with clock.	Stay-warm thermal underwear.
DPHD1	**DPHD2**	**DPHD3**	**DPHD4**
Coats with built-in posture aiding memory foam to support sitting.	IDC – accreditation mark to recognize inclusive design.	Buddying correspondence scheme between elderly and orphans.	Internet-based service offerings by the elderly.

Legend

- Product
- Safety
- Promo
- Service

Table 3. Number of designers engaged in activities (max. 4 in each designer category and 12 in total)

	Studying the brief	Planning the design process	Collecting information	Looking at examples	Consulting with others	Thinking about solutions and sketching them	Analyzing/comparing alternatives	Evaluating interim and the final proposal(s)	Preparing the final presentation
ID	4	1	1	2	3	4	3	2	4
ARCH	4	0	4	4	3	4	2	2	4
DPHD	4	4	3	4	3	4	4	3	4
Total	**12**	**5**	8	10	9	**12**	9	7	**12**

Table 4. *Chronological order of the activity "Thinking about solutions and sketching them"*

Undergraduate students (mean: 6.4 activities)								Graduate students (mean: 8.3 activities)			
Industrial Design				**Architecture**				**PhD in Design**			
ID1	ID2	ID3	ID4	ARC H1	ARC H2	ARC H3	ARC H4	DPH D1	DPH D2	DPH D3	DPH D4
2	4	3	2	3	3	3	3	6	6	6	1