The Reflection of Experiential Knowledge Into Professional Practice: Case of Industrial Design Education

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Abstract: Industrial designers, perform as professionals in various disciplines unrelated to design as well as conventional professional practice. During several professional and non-professional occasions it has been observed that designers’ knowledge of problem solving, multi-directional thinking, inclination to team work shows up during everyday life and is used both in everyday situations and also in professional workflow. Industrial design knowledge, has a compound nature, with close contact with engineering, ergonomics, business, aesthetics, society, environment and culture. The aim of the study is to investigate how practitioners graduated from industrial design departments use design knowledge while performing outside orthodox industrial design fields. With this aim, first the nature of industrial design education and its contribution to the design students was examined through theories about the experiential and explicit knowledge of design education. To further discuss the arguments with practitioners’ experiences, an exploratory field research was conducted.

Keywords: Experiential knowledge, industrial design, design education, learning by doing, action research

1. Introduction

Industrial design, with its combinatorial nature, has a close contact with the disciplines such as engineering, ergonomics, business, aesthetics and even social, environmental and cultural issues (Yang, You, & Chen, 2005). This integrated nature of industrial design discipline, forces its practitioners to be large-minded and versatile. Hence, the designer, alongside his individual cognitive skills and comprehensive design vision, he also needs to hold various skills such as reconciliation with the clients, problem solving, interpersonal skills, project management and responsibility for the outputs of the process (Lewis & Bonollo, 2002). As a natural outcome of this, it is widely observed that design graduates can find a job in various sectors in industry, even it is quite typical that designers tend to enterprise their own business models in to the market (Temeltaş, 2011).

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Throughout the product development process, a conscientious industrial designer needs to get involved in all aspects of the life-cycle of the product from the initial idea to the interaction of the product with the end-user and needs to take possession of the entire process. Furthermore, designers, in the next decade, are expected to have the knowledge relevant to marketing strategy, market analysis, product planning, mechanism and structural design, CAID for the various design tasks, an active attitude, communication skills in foreign languages and international views as well as having the traditional skills (Yeh, 1999).

In this sense, it is important to examine the nature of industrial design education and its contribution to the design students. In order to educate such equipped individual designers, Industrial Design (ID) departments, provide a large variety of elective courses including engineering, ergonomics, management, arts, and computer-related courses (Yang et al., 2005). While these courses help students to gain a broader understanding of the design tasks in the product development process, they also help to broaden students’ vision about other design related fields, such as product planning, design management, mechanism design, CAID, human-machine interface, arts, etc. This multifaceted structure of industrial design education, leads its graduates to become successful practitioners of other sector.

2. Tacit knowledge and professional practice

In the course of tacit knowledge, if one would like to explore the roots of the discourse, he/she needs to engage with the interpretation of Donald Schön on the literature. Although the philosopher and researcher reformist Michael Polanyi made the initial attempts to investigate the tacit dimension of human brain and knowledge acquisition, Donald Schön’s approximation of the discourse in relation to design education and design itself, has opened a very wide road for debate. Later on, more current interpretations made by researchers such as Bruce Archer (1995), Chris Rust (2007), Michael Biggs (2007), Owain Pedgley (2007) and they brought the debate to its contemporary elevation. It is still a hot topic among the design researchers and being argued with diverse opinions in the academy.

In this part of the paper, Donald Schön’s ideas about tacit knowledge and its relevance with the professional practice is going to be discussed, especially benefited from the Leonard Waks’ “Donald Schön’s Philosophy of Design and Design Education” (2001). Schön (1988) argued that, design process is a reflective conversation between the designer and the materials of a given design situation which is based on intuition, logical treatment and rigorous reasoning (Salama, 2008). Schön also presents the idea that all professional practice is “design-like” (Waks, 2001). According to Schön, practitioners such as architects, engineers and industrial designers, along with their practices, have their unique, internal knowledge sets. These knowledge sets lead to create a strong tacit knowledge for practitioners. In case of practitioners encounter with messy problems, the solution pops out under domination of tacit knowledge, they reflect-in-action and through their unique way, the land of practice. Schön also argues that the ideal professional education type is the format of design education and this new education proposal of his is in the scope of whole education system, both for university and primary-secondary education.

As Cited by Waks’ (2001), Schön claims that three diverse tacit knowledge acquisition form is present. First is in the form of self-instruction. The second is apprenticeship; the third and possibly the most valid one is practicum where the novice learner experiences the preset problems under close supervision of a master. In this form of knowledge acquisition, the novice and the master come to a close integration on a defined problem and tries to “solve” it by idea exchange and talking-
working together. They start to reflect their ideas reciprocatively, thus they produce knowledge collectively. Both the novice and the master benefit from the produced knowledge, as it is a new and unique one. As they proceed to work closely on diversified problems together and collectively, they continue to construct new knowledge and it goes on, hence it is an iterative process. As a result of their relationship, the novice gradually become experienced and he/she starts to possess his/her own attitude in the practice. Also the master acquires from the experimentation with the novice and he is not the same as he was.

When we have a look at the current design education, we can, in a breeze, observe the three forms of tacit knowledge are present. If we make an analogy between design education and apprenticeship in craft, the design student represents the novice, design educator the master and the design studio the atelier. The design problem is communicated by the design brief provided by the educators. The student is iteratively engaged with the design brief in consultation with the educator. They collectively produce design solutions in order to meet the expectations of the design brief.

During the design education, design students, most importantly develop a sense of problem solving in an idiosyncratic way and a unique, broad vision for observing the environment which surrounds them. They look for opportunities, seek for authentic problems and inventive solutions to ‘yet-inexistent’, conceptual problems. This inherent ability which is loaded to the design students, accompany them during their life and actually it turns into a procedure of ‘life-long learning’. One can easily observe that, a designer, in comparison with representatives of other professions, reflects a broader vision and observation skills in certain circumstances. Because; the natural and most important skill of a well-trained designer is the sensation of potential improvements for the existing situation. Most probably, Herbert Simon (1969)’s definition of design is the most convenient description for the above mentioned situation: “Design is devising courses of action aimed at changing existing situations into preferred ones.” (Simon, 1969)

Based on this definition of design, it can be argued that, a designer, no matter if he/she practices in design related area or not, always seek for changes in the existing situations for better ones. In the further parts of the paper, a comparative action research method is going to be used in order test this hypothesis.

3. The nature of industrial design education

Until recently, design and its practice has heavily been associated with the individual skills of the designer (Salama A., 1995). However, recently it has turned out that, design is more process oriented rather than product, and it has started to be considered as a conscious activity by many researchers (Andjomshoaa, Mokhtabad-Amrei, & Mostafa, 2011). According to Wormald and Rodber (2008) it is also evident that promoting “design-thinking” is more beneficial than promoting “design” itself according to the changing circumstances of industry. Additionally, Matt Hunter, CEO of IDEO, announced that they had to shift the route of their company from designing products to design thinking in business (Wormald & Rodber, 2008).

By taking into consideration above mentioned progression of the industrial design profession, the design education is being updated accordingly since the beginning of 21st century. Typically design, both in education and professional practice starts with a well written brief which clearly defines the problem and the designer/student designer is expected to come up with convenient solutions for this problem (Wormald P., 2011). Based on this, industrial designers are naturally expansive and open his/her problem solving activities. These problem solving activities are usually more intense at the early stages of the design process and seemingly more difficult to solve. Hence, what is expected
from a designer is to develop abilities to find problems and to see the “big picture” (Wormald P., 2011). Apparently, the role of the industrial design education is to expand the designer’s role to find the problem, to seek for the opportunities exploiting the sources such as technology, material and physical resources by using a fully user-centered approach. In order to achieve this holistic approach, it is observed that many universities all around the world tend to use user research activities in the last decade such as “context mapping” (Stappers & Sleeswijk, 2007), observation of user behavior (Siu, 2003), user-focused design research (Alexis, 2006), ethnographic observation etc. (Christensen, 2010). It is individually stated by the authors that students become more emphatic with the users and gaining insight into relevant behavior.

Knowledge management has been studied in two distinct concepts as far: explicit and implicit knowledge. Implicit knowledge, also known as tacit knowledge plays a major role in complex problem solving and is the primary source for professionals and experts in performing their routine activities (Andjomshoaa et al., 2011). As industrial design education is an important domain of problem solving, it has its roots on the knowing-how domain of knowledge which is implicit-tacit knowledge. According to Busch (2004), the two distinct characteristic of knowledge acquisition occurs in tacit knowledge, one is originated by the intimate relationship between a master and an apprentice, the second is learned experience during time. In considering this “knowing-how” and “subjectivity” of tacit knowledge, industrial design education directs students to widen the implicit side of their brain by encouraging them to use methods such as mind-mapping, brain-storming, synectics, morphology, role-playing, creating personas, storyboards etc. These methods are the important touchstones of the design education as they lead students’ to externalize their tacit knowledge. Other than that, externalization techniques such as sketching, doodling, design drawings, three-dimensional models, bio-mimicry, context mapping are regardfully taught and pushed to be experienced by design students. With the help of these externalization techniques, the tacit knowledge of the design students is materialized and further the progression of the implicit side of their knowledge domain is enabled. Eventually, design students are able to develop a unique and idiosyncratic cognitive ability. This cognitive difference that designers obtained, open a road for them a self-reliance and courage to attempt various professional practices in different sectors even out of the scope of design field.

It was found out from the design education literature that, a unique way of tacit knowledge exists in the domain. Designers tend to attempt to define or understand the problem fully before making solution attempts which separate them other kinds of problem solvers and many design behavior studies suggest that designers move rapidly to early solution conjectures and use them as a way of exploring and defining problem-and-solution together (Cross N., 2004). The solutions which are proposed by designers remind them of issues to consider, thus the problem and solution co-evolve (Kolodner & Wills, 1996). As Dorst and Cross (2001) reported designers start by exploring the problem space and they establish a partial structure. That structure helps them to come up with a partial structure of the solution space. The initial ideas inferred from that solution space lead them to visit back the problem space in an iterative circle so that the goal of creating a matching problem-solution pair is tried to be achieved. Being solution-focused rather than problem-focused appears to be a feature of design cognition which comes with education and experience in design (Cross N., 2004) which is called as ‘designerly ways of knowing’ by Cross (2006). This unique way of knowing and tacit dimension of designers’ is the fundamental factor that lead designers to perform in various different disciplines.
4. Method

In this part of the paper, research method used for the examination is going to be explained. Since the main aim of the study is to investigate whether practitioners graduated from industrial design departments performing in areas other than design utilized from the knowledge that they gained during their undergraduate study or not, both industrial design graduates and the graduates of the other disciplines were interviewed. Designers who perform in other fields were identified as the participants of this inquiry. From this opportunistic sampling their practicing fields which are photography, ceramics and jewelry became the disciplines of investigation in the study.

4.1 Research Sample

The research sample consists of 6 participants – their background, current occupation etc. is given in Table 1. Background info is related to their undergraduate education; current occupation info is their present engagement with their profession.

As seen in Table 1, all of the participants are both entrepreneurs and determined individuals in terms of their practice with established expertise in their working area. Working with the experts in such research studies is important as mentioned by Casakin and Goldscmidt (1999) because experts tend to focus on more profound features. Also, as practitioners progress in their profession as experts, the knowledge domain they hold becomes more structured and better integrated with past experiences. Because of the limited number of designers analyzed in this research study, we do not intend to draw general conclusions from the experimental results.

| Participant | Background | Current Occupation                      | Details                                                  |
|-------------|------------|-----------------------------------------|----------------------------------------------------------|
| A           | Industrial Design | Academician                           | Lectures photography class for industrial design students |
| B           | Photography                        | Photographer                             | Freelance photographer, home Office                      |
| C           | Industrial Design                     | Design and produce ceramic products     | Owns his own brand, home office                          |
| D           | Ceramics                             | Design and produce ceramic products     | No brand for her products, owns atelier                  |
| E           | Industrial Design                     | Design and produce metal jewellery products | Owns her own brand, home office & atelier              |
| F           | Jewellery                           | Academician                             | Performed as a jewellery designer after her graduation for 3 years |

4.2 Setting The Research Environment

Participants were visited in their casual working environment. It is aimed at to make the subjects feel comfortable in their conditions and to avert the external discomforts originated from outer environment. It was also important to observe them in their daily routine.
4.3 Data recording technique

As it is argued by Pedgley (2007) it is important to use multiple data collecting methods in order to triangulate data and results. Compatible with the data triangulation idea three different data recording techniques were used. First one is the camera recording. Before action starts and while the preparations of the subjects proceeding, the camera was immobilized on a tripod where the stand point the camera is wide enough to record the activities during the photo shoot. When the subjects were ready to be recorded and focus on their activity they were informed that they are under recording and the record started. The camera proceeded to record during the whole process.

The second data recording technique used was taking photographs of the participators and the environment. The aim of using this second technique was to enhance the efficiency of the observation. As the video camera is immobilized on a certain point of the environment, taking photos gave author a freedom of movement. In case of missing any detail by the video recording, taking pictures provided a better focus for the details.

The third data recording technique was voice recording. When the photo shoot ended with final outcomes, the photographers were asked to tell the details about their photo shoot and final outcome. They explicitly interpreted their actions during the activity and the final photographs. It was important because, although the author was present in the environment during action, it was difficult to give meaning to the behavior and activities of the participants. When the needed interpretation made after the photo shoots, the entire process became clearer to the author.

5. Analysis Framework and Findings

As the aim of this study is to present the reflection of tacit knowledge gained in industrial design education, it is important to understand the concept of creativity in design and creativity domains. Creativity has been comprehensively investigated under the domains of engineering design and cognitive psychology (Howard, Culley, & Dekoninck, 2008). According to Howard et al. (2008) both domains refer to creativity with similar approaches while the domain of cognitive psychology use commonly creative ‘process’, creative ‘product’, creative ‘individual’ and creative ‘environment’ (Rhodes, 1961; Murdock & Puccio, 1993; Basadur, 2000), domain of engineering design categorizes design into sections by using the terms the design ‘problem’, the design ‘process’, the design ‘types (output)’, the design ‘activity’ and the design ‘organization/team/personnel’ (Pahl & Beitz, 1984; Ulrich & Eppinger, 1995; Ullman, 1997; Cross, 2000).

Howard et al. (2008) provided a comprehensive engineering design (Table 2) and creative process (Table 3) models in their study. According to Howard et al. (2008), engineering design has four main phases which are analysis of task phase, conceptual design phase, embodiment design phase and detailed design phase. Similarly, creative process has four fundamental stages which are analysis phase, generation phase, evaluation phase and implementation phase. These four main stages observed in both domains are going to constitute of our analysis framework. Findings derived from the recorded data are going to be examined according to this framework in the further sections of the study.
Table 2. Comparison of engineering design process models (Howard et al., 2008)

| Models                        | Analysis phase                                      | Generation phase                                      | Evaluation phase                                      | Communication phase                                      |
|-------------------------------|------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------|
|                               | Establishing a need                                 | Analysis of task phase                                | Conceptual design phase                               | Embedding design phase                                   | Detailed design phase                                    | Implementation phase                                    |
| Root et al. (1967)            | X                                                    | New product strategy development                     | Idea generation                                       | Screening & Evaluation                                    | Business analysis                                        | Development                                              | Commercialization                                       |
| Archer (1968)                 | X                                                    | Programming                                           | Data collection                                        | Analysis                                                | Synthesis                                              | Development                                             | X                                                      |
| Svensson (1974)               | Need                                                | X                                                     | Concepts                                              | Verification                                            | Decisions                                              | Communication                                           | X                                                      |
| Wilson (1989)                 | Societal need                                        | X                                                     | Constraints                                           | Ideate and create                                       | Analyse and/or test                                      | Product, prototype, process                             | X                                                      |
| Urban and Hauver (1989)       | Opportunity identification                          | Design                                                | Testing                                               | Testing                                                  | Introduction                                            | Life cycle management                                   | X                                                      |
| VDI-2222 (1982)               | X                                                    | Planning                                             | Conceptual design                                      | Embedding design                                        | Detail design                                           | Commercialization                                       | X                                                      |
| Hubka and Elder (1982)        | X                                                    | X                                                     | Conceptual design                                      | Lay-out design                                          | Detail design                                           | X                                                      | X                                                      |
| Crawford (1984)               | X                                                    | Strategic planning                                    | Conceptual design                                      | Pre-technical evaluation                                | Technical development                                    | Commercialization                                       | X                                                      |
| Pahl and Beitz (1988)         | Task                                                | X                                                     | Conceptual design                                      | Embedding design                                        | Detailed design                                         | X                                                      | X                                                      |
| French (1985)                 | Need                                                | Analysis of problem                                   | Conceptual design                                      | Embedding of schemes                                    | Detailing                                               | X                                                      | X                                                      |
| Ray (1985)                    | Recognize problem                                   | Exploration of problem                                | Define problem                                          | Search for alternative proposals                        | Predict outcome                                         | Test for feasible alternatives                          | Judge feasible alternatives                             | Specify solution                                         | Implement                                               | X                                                      |
| Cooper (1986)                 | Idea                                                | Preliminary investigation                             | Detailed investigation                                  | Development                                             | Testing & Validation                                     | X                                                      | Full production & market launch                         | X                                                      |
| Andreasen and Hein (1987)     | Recognition of need                                 | Investigation of need                                 | Product principle                                      | Product design                                          | Production preparation                                   | Execution                                               | X                                                      |
| Peith (1991)                  | Market                                              | Specification                                         | Concept design                                         | Detail design                                           | Manufacture                                            | Sell                                                    | X                                                      |
| Halls (1993)                  | Idea, need, proposal, brief                         | Task clarification                                    | Conceptual design                                      | Embedding design                                        | Detail design                                           | X                                                      | X                                                      |
| Baumer (1995)                 | Assess innovation opportunity                       | Possible products                                      | Possible concepts                                       | Possible concepts                                       | Possible embodiments                                    | New product                                             | X                                                      |
| Ulrich and Eppinger (1995)    | X                                                    | Strategic planning                                    | Concept development                                    | System-level design                                     | Design                                                 | Testing & refinement                                     | Production ramp-up                                       | X                                                      |
| Ulman (1997)                  | Identify needs                                      | Plan                                                  | Develop engineering specifications                     | Develop concept                                         | Develop product                                         | X                                                      | X                                                      |
| Ishikawa (1997)               | Concept                                             | Feasibility                                           | Implementation (or realization)                        | Termination                                              | X                                                      | X                                                      | X                                                      |
| Black (1999)                  | Brief / Concept                                     | Review of ‘state of art’                              | Synthesis                                              | Analysis / Reflect                                      | Synthesis                                              | Decisions to constrain                                  | Output                                                  | X                                                      |
| Cross (2007)                  | X                                                    | Exploration                                           | Generation                                             | Evaluation                                              | Communication                                           | X                                                      | X                                                      |
| Design Council (2006)         | Discover                                            | Define                                                | Develop                                                | Deliver                                                 | X                                                      | X                                                      | X                                                      |
| Industrial Innovation Process 2006 | Mission Statement                  | Market research                                        | Ideas phase                                            | Concept phase                                           | Feasibility phase                                      | Pre-production                                          | X                                                      |

Table 3. Comparison of creative process models (Howard et al., 2008)

| Models                        | Analysis phase                                      | Generation phase                                      | Evaluation phase                                      | Communication phase                                      |
|-------------------------------|------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------|
|                               | Establishing a need                                 | Analysis of task phase                                | Conceptual design phase                               | Embedding design phase                                   | Detailed design phase                                    | Implementation phase                                    |
| Dewey (1910)                  | A felt difficulty                                   | Definition and location of difficulty                 | Develop possible solutions                            | Implication of solutions                                 | Experience collaboration of constructial solution       | X                                                      | X                                                      |
| Wallis (1952)                 | Preparatory                                          | Preparation                                          | Incubation                                             | Illumination                                            | Verification                                           | X                                                      | X                                                      |
| Polya (1957)                  | Understanding the problem                           | Developing a plan                                     | Carrying out plan                                      | Looking back                                             | Communication                                           | X                                                      | X                                                      |
| Guilford (1957)               | X                                                    | Divergence                                            | Convergence                                            | X                                                      | X                                                      | X                                                      | X                                                      |
| Buhl (1960)                   | Recognition                                          | Definition                                           | Preparation                                            | Analysis                                                | Synthesis                                              | Evaluation                                             | Presentation                                           | X                                                      |
| Osborn (1963)                 | Fact-finding                                        | Problem-solving                                      | Idea-finding                                           | Solution-finding                                        | Acceptance                                             | Action                                                 | X                                                      | X                                                      |
| Parnes (1987)                 | Problem, Challenge, Opportunity                     | Fact-finding                                         | Problem-finding                                        | Idea-finding                                            | Solution-finding                                        | Acceptance                                             | Action                                                 | X                                                      |
| Jones (1970)                  | Search data                                          | Understand the problem                                | Pattern holding                                        | Flashes of insight                                      | Convergent                                              | X                                                      | X                                                      |
| Stein (1974)                  | X                                                    | Hypothesis formulation                                | Hypothesis testing                                     | Communication                                           | X                                                      | X                                                      | X                                                      |
| Paris (1981)                  | Mass-finding                                         | Problem-finding                                      | Idea-finding                                           | Solution-finding                                        | Acceptance                                             | X                                                      | X                                                      |
| Amabile (1983)                | Problem or task presentation                        | Preparation                                          | Response generation                                    | Response validation                                      | Outcome                                                | X                                                      | X                                                      |
| Barron & Arregurin (1981)      | X                                                    | Conception                                           | Gestation                                              | Partition                                               | Bring up the baby                                       | X                                                      | X                                                      |
| Iseki et al. (1994)           | Constructing opportunities                          | Exploring data                                        | Framing problem                                        | Generating ideas                                        | Developing solutions                                    | Acceptance                                             | X                                                      |
| Cooper et al. (1993)          | Opportunity, definition, problem definition          | Compiling information                                 | Generating ideas                                       | Evaluation                                              | Developing an implementation plan                       | X                                                      | X                                                      |
| Silberstern (2000)            | Collect                                              | Collect                                              | Relate                                                 | Create                                                  | Communication                                           | X                                                      | X                                                      |
| Basadur et al. (2000)         | Problem-finding, fact-finding, problem definition    | Idea-finding                                          | Evaluate and select                                     | Plan-Approval-Action                                     | X                                                      | X                                                      | X                                                      |
| Kryssnov et al. (2001)        | Functional requirements                              | Structural requirements                               | Functional solutions                                   | Analogies, Metaphors                                     | Reinterpretation                                       | X                                                      | X                                                      |
Figure 1 represents the analysis framework which is derived from the Howard et al. (2008)’s proposal of engineering design and creativity process which are represented in Table 2 and 3. As seen in Figure 1, there are three investigated disciplines; photography, ceramics and jewelry. 2 participants were examined from each discipline; one is graduated from industrial design department and the other is graduated from the related bachelor degree. The narrations in the recorded interviews were analyzed by searching different problem solving patterns reported by the compared participants based on the researcher’s own product design knowledge and experience. From this evaluation, the identified problem solving patterns were conceptualized as keywords seen in Figure 1. The evidence from the participants’ reports forming the mentioned keywords were presented in the related subsections where each phase is discussed.

5.1 Analysis Phase / Establishing a need Phase

As seen in Table 2 and 3 analyzes phase is related to the recognition, definition, preparation and the analysis of a problem. Participant’s engagements in analysis phase are going to be discussed in this subsection.

Participant C and D – representatives of ceramic discipline were asked to produce one of their favorite products and to express their initial ideas related to that product in its design phase. In the analysis, namely pre-design phase Participant C starts his initial ideas related to the product by considering target market. He aims to design and produce products which can be adopted by this target group. In order to fulfill that aim, he actually creates ‘personas’ not explicitly but tacitly which are one of the fundamental outputs of design education. However, Participant D – ceramic artist told that she designs products in a freer manner, for example she writes stories related to her products. Her recognition of the problem in the pre-design stages is more abstract. She doesn’t directly aim a target group; her design activity is more artistic. Their analysis phase approaches were conceptualized as ‘target focused’ and ‘abstract’ as seen in Table 4. Figures 3 and 4 represent the products of Participant C and D.
Participant E stated that in the initial stages of her design activity, she always tends to suppose that her designs are going to be manufactured in mass. This presupposition shapes her design related decisions yet in the analysis phase, which she declared later that her tendency to mass production is coming from her industrial design background. “Reproducibility” stands out as major concern.
5.2 Generation Phase

This phase of creativity is mostly related to ideation, inspiration, incubation and concept
development processes of an idea.

Participants A and B – representative of photography discipline were asked to photograph an object.
It was observed that during the analysis phase both of them developed different reflexes. Participant
A – the industrial designer set the scene rapidly with his self-designed tripod extension and
photographed the object on it. He was able to perform this activity by himself with the help of his
design. However, the photographer, set the scene in a quite professional manner which took a
relatively long time, also during the photo shoot he had to receive help from his assistants. Here,
Participant A proceeds in a “solution-based” manner whereas Participant B uses an “experience-
based” approach. Figure 5 and 6 represent the scene setting of Participant A and B.

Participant C mainly uses clay mock-ups in generating new ideas related to his designs. These mock-
ups give him the sense of the size, texture, real outlook of a product while Participant D starts with
sketches to her idea generation phase.

Participant E stated in the generation phase she took advantages of both building mock-ups and
sketches depending on the project that she works on.

Figure 4. Self-designed tripod extension of Participant A
5.3 Evaluation Phase / Embodiment Design Phase

This phase is the final phase of the creative activity. In this phase the initial ideas and generated design decisions transform into physical outputs. It is related to verification, testing, reinterpretation, evaluation of the ideas generated until this phase. If the generated ideas can pass this phase they move forward to detailed design phase, otherwise the process turns back to the first analysis phase.

It was observed that all of the participants come up with a kind of physical output in this stage and test their ideas with the help this physical output. In case of photography this physical output is the first photograph produced by the artist, while in ceramics it is the raw ceramic product and the jewel in jewelry.

Participant B represented a strong iterative attitude in this stage as he was not satisfied with the results of the photograph. He recurrently adjusted the position of the lights, background, the object itself etc. When he satisfied with the result he further proceeded the reproduction of the images.

Participant D declared that she somehow feels satisfied with the result at this stage and proceed to the further stages. She has a more romantic manner in this stage as she writes stories and poets related to her ceramic figures and objects.

Participant E stated that she designs her products by not following the main stream trends and market. Hence, in order to proceed, she needs to feel satisfied with the outlook of the product in this stage. She tries to reflect her likings and style to her products and she declared that it is something tacit that you know it is already a product or not.

5.4 Communication Phase / Detailed Design Phase

Until this phase, creativity process reaches to a saturation and during this phase the design or the activity is finalized. As seen in the Table 2 and 3 technical developments, detailed design functions, presentation and communications aspects are assessed.
Participant B applied final retouches to the photographs that he took during the process by the help of third party applications such as Photoshop and Illustrator. Participant C and D apply glazing with the desired color and texture then bake the products in oven. Participant E performs coating on the surfaces of jewels her unique technique. She stated that craftsmen perform this coating application by using brushes. However, her products need a more meticulous workmanship as her design details include straight and fine finishing aspects. She tried to use acetate pen in order to improve the coating function. Although craftsmen denied to use this technique at first, then they adopted the method in their routine process. It was observed that industrial designers transfer their knowledge and capabilities in case of cross disciplinary studies.

Participant C represented a similar tendency in facilitating the production process by using self-designed molds, templates and glazed color sticks. By the help of these facilitators that he designed during the design and production processes he could be able to come up with consistent products and outputs. The use of acetate pen by the jeweler and the self-designed molds of C were conceptualized as “facilitator-mass produce”.

![Image](Figure 6. Example of applying coating by using acetate pen of Participant E)

![Image](Figure 7. Self-designed colour sticks of Participant C)
5.5 Discussion

It was observed during the field research Industrial Designers have a strong ability to adopt in different disciplines. They can reflect their gained knowledge related to problem solving activities into other disciplines and they can transfer this knowledge to other domains.

As a result of the literature review and field research sustained with the participants, it can be concluded that creative areas such as industrial design, photography, ceramics and jewelry push its practitioners to be open minded and seek for the opportunities to support ease to their practical work. Although the literature findings given in the beginning of the paper suggest that industrial design education provides its practitioners tacit knowledge, hence it enables a process for the design students which activates the life-learning, in the field research it was observed that the other participants coming from different disciplines reflect similar characteristics. They use their building skills to develop needed equipment for their practice. This might be derived from all of the practitioners were educated in a creative field. In this regard, it would be more convenient to apply the research method to the individuals coming from totally different disciplines such as marketing, management or accounting in order to test the effect of design education to individual’s behavioral and cognitive skill development.

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Table 4. Conceptualized keywords from the data recordings

| Disciplines | Analysis Phase / Analysis of Task Phase | Generation Phase / Conceptual Design Phase | Evaluation Phase / Embodiment Design Phase | Communication Phase / Detailed Design Phase |
|-------------|----------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|
| Photography | Defining | Solution-based | Quick | Archive |
| (B) Planning | Experience-based | Authentic | Retouch |
| Ceramics | Target focused | Mock-ups | Trendy | Facilitator – Mass produce |
| (C) Abstract | Sketches | Romantic | Dissimilarity |
| Jewelry | Reproducible | Mock-ups | Tacit | Facilitator – Mass produce |
| (E) Abstract | Sketches Mock-ups | Authentic | Dissimilarity |
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