Understanding the Verbal Concepts Appropriated by the Students in the Architectural Design Studio

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The main aim of this study is to gain a better understanding of the role of verbal concepts in the architectural design processes of the students in a studio context. To serve this purpose, we carried out a 15-week studio in an urban architectural masters design studio at KU Leuven Faculty of Architecture. We observed the use of verbal concepts in time during this studio and analyzed the design processes of the students based on their self-report logs on the studio web platform. Based on these, we conducted a statistic analysis and a network mapping study. We found that early concepts provide a starting point for developing fully-fledged specialized design ideas. Furthermore, a higher number of links between concepts indicated their importance during the process. In addition, the data collection and research methods proved to be reliable for mapping the design process of the students as well as revealing the evolution of the ideas in the studio.

Keywords: Design Studio, Concepts, Crowdsourcing, Web Platform, Self-reporting, Design Research

INTRODUCTION
In this study, we use the term "verbal concept" to describe "verbal units of information that designers stress as important" during the design process (Schön and Rein 1994). According to Schön, designers impose a network of 'names' on to the design task and the design situation which helps them to frame the design task and solution (Dorst 1997). Examples of these names (or verbal concepts) for a particular design process is: 'spatial identity, social interaction, informal networks, and dislocation' (Schön and Rein 1994).

In literature, it is possible to find a plethora of references to verbal concepts used in design and their possible attributes. However, there are only a few number of empirical research studies on how different types of these concepts play a role in various phases of design and design studio learning.

Motivated by these observations, we aim to develop a better understanding of this topic and specifically address the following questions:

• How can we research the verbal concepts appropriated by the students during the architectural design studio?
• Can verbal concept maps and statistics of self report logs reveal knowledge on these? and how are they related to the design processes of the students?

Section 1 will introduce a background review of verbal concepts in design process. In the following section (Section 2), we will introduce the method of the
study and the hypotheses. Section 3 will reveal the analysis results from the studio work we carried out during the Spring 2015 semester. In conclusion (Section 4), we will discuss the findings and make suggestions for future research on the role of verbal conceptual representations in architectural design and design learning.

BACKGROUND

In design research, the term 'concept' has more than one meaning. First of all, a 'design concept' may refer to a complex construction incorporating mental units; an assemblage that gathers the intricacies of the project as a collection of responses to a particular problem (Teal 2010, p.301). In this context, a 'design concept' is an idea that drives many of the major preliminary design decisions (Goldschmidt and Sever 2011, p.139). This idea embodies several features in the form of an early design defined as representations which are essential for developing the concept into a fully-fledged design (Cross 2006, p.66).

Alternatively, the term 'concept' may refer to units of information that designers stress as important during the design process. From a problem solving perspective, these are 'verbal conceptual representations' that play an essential role in establishing relationships for transforming physical or social relations into a functional idea (Akin 1986, p.75). Schön (1994, p.26) calls these 'names' or features and relations that become the things of a story. According to Schön, designers impose a network of 'names' onto the design task and the design situation which helps them to frame the design task and solution (Dorst 1997). Examples of these verbal concepts were identified by Schön in a specific design study as: 'spatial identity, social interaction, informal networks and dislocation'. In literature, it is possible to find a plethora of references to verbal and non-verbal concepts used in design and their possible attributes.

According to Waldron and Waldron (1988), initial concepts are related to the early design phase, they provide a necessary starting point and could be partly fallacious or critical to the procedures that will follow (Cross 2006, 34). Initial concepts are not necessarily consistent, they are alternatively named as 'early concepts' that have an effect on the quality of design solutions; and successful early concepts do not necessitate alternative concepts for further development (Cross 2006, 06).

Goldschmidt and Tatsa made an empirical study on leading concepts (2005). They carried out a design studio experiment in which data was collected by an experimenter throughout the semester. They inspected students' conceptual ideas quantitatively in the course of development of their term projects and tried to establish possible correlations between the quality of final projects and various parameters related to their design ideas. The study shows that good ideas can be identified, counted and characterized by looking at the links they generate. Leading concepts can be associated with good ideas as they are described as useful concepts that lead good designs (Goldschmidt and Tatsa 2005, p.603). According to this study, leading design ideas have a higher number of links that are formed among ideas or decisions. This study suggests that a higher number of links indicate the criticality and importance of the ideas or concepts (Goldschmidt and Tatsa 2005, p.606).

RESEARCH DESIGN

In order to respond the research questions, a 'living laboratory' was set up in an International Urban Architectural Design Master’s Studio at KU Leuven University, Faculty of Architecture in Brussels during 15 weeks of 2014/2015 spring semester. The participants were 43 international architecture students (25 females and 18 males) in their first or second year of master studies.

A web-based research platform for augmenting design learning (Pak and Verbeke, 2012)(Pak and Verbeke 2014) was set up for collecting information from the students, which also included the studio brief, schedule, bibliography, program, announcements, communication and assignment submissions.

Every two weeks, an assignment challenge was
announced which required the students to submit their work through the online platform. With every submission, they were asked to provide up to five keywords (open question, e.g. connection, integration, productive) and choose at least one of the ten concept-couples suggested by the groups at the beginning of the semester (multiple choice, e.g. density-uniformity, frontstage-sideline, foundspace-sterilespace). By doing so, students created self-reporting logs (concepts) on the platform as design diaries which formed a basis for the source data for our research.

After a review of concept categories in literature, we decided to focus on two types of concepts: leading and unique concepts. A repeating concept is counted as a leading concept in all submissions and included in the count except the last one.

**Identifying and Coding Novel and Leading Concepts.** Novel concepts are the concepts that are used for the first time in a student’s submission. They are counted as a novel concept only when they are first used. For instance, ‘diversity-uniformity’ was identified as a novel concept when it appeared in the first submission and categorized as a leading concept for the second submission.

**Identifying and Coding Unique Concepts.** A unique concept is used for only one time during the semester in the entire studio.

After documenting all the concepts that are used, we determined the quantity of the unique concepts and their distribution among students. Based
on our literature review we tested six hypotheses. Since we have limited space in this conference paper, we will report only two of them:

- H1 Early concepts provide a starting point for developing fully-fledged specialized design ideas (Cross 2006, p.106)
- H2 Higher number of links between concepts indicate the criticality and importance of the ideas or concepts (Goldschmidt and Tatsa 2005)

ANALYSIS RESULTS
With the accumulation of design diaries on the web-based research platform, we collected every verbal conceptual representation of design ideas and analyzed their correlations in the context of their novelty, uniqueness, lead, and quantitative limitations. During the 15 weeks of the studio semester, 479 concepts were reported through 9 assignment submissions. 10 of them were concept- couples derived from students' pin-up presentations and suggested by the instructors, and 469 of them self-reported by the students. 240 of 469 were unique concepts reported only once. The three most used concepts were 'connection, integration and productive' (Table 1).

We made a statistical analysis of the novel and unique concepts and their several correlations to examine the hypotheses. To test the hypotheses(1 and 2), we used Cytoscape software for visualizing network relations of concepts suggested by the students.

**Hypothesis H1: Early concepts provide a starting point for developing fully-fledged specialized design ideas.** In order to test the hypothesis of Cross (2006), we analyzed how students describe the development of their ideas with verbal concepts during the semester. We linked nodes of concepts that are reported by each student to the group concepts with edges in Cytoscape software to create a concept map. Cytoscape is a software designed initially for integrated models of biomolecular interaction networks. Within this software environment, molecular species were represented as nodes and their interactions were represented as links, namely, edges between nodes (Shannon et al. 2003, 2499). In our study, each verbal concept was represented as a node and linked concepts were represented with edges in between. For instance, concepts that are reported together for the same assignment were represented as nodes and linked with edges; whereas concepts that are reported later, but linked to a previously reported concept were also represented as

<table>
<thead>
<tr>
<th>Concepts suggested by students</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>connection</td>
<td>22</td>
</tr>
<tr>
<td>integration</td>
<td>22</td>
</tr>
<tr>
<td>productive</td>
<td>17</td>
</tr>
<tr>
<td>belonging</td>
<td>16</td>
</tr>
<tr>
<td>productivity</td>
<td>14</td>
</tr>
<tr>
<td>community</td>
<td>13</td>
</tr>
<tr>
<td>diversity</td>
<td>13</td>
</tr>
<tr>
<td>edge lands</td>
<td>12</td>
</tr>
<tr>
<td>public space</td>
<td>12</td>
</tr>
<tr>
<td>activity</td>
<td>11</td>
</tr>
<tr>
<td>temporality</td>
<td>11</td>
</tr>
</tbody>
</table>

Table 1
The 10 most frequently used concepts by the students.
nodes and linked with edges to a former concept. Therefore, all related concepts are linked with edges and repeated links are represented thicker.

Cytoscape software provides network analysis function as well as a variety of visual representations of the integrated data. With a network analysis we achieved the edge betweenness rates (Girvan and Newman 2002) of links between nodes (Table 2). The concepts 'front stage-sideline' and 'found space-sterile space' are the highest rated concepts in terms of their links; and they are concepts reported for the first and third assignments. These results show that final designs of the students use early concepts as a basis.

**Hypothesis H2: Higher number of links between concepts indicate the criticality and importance of the ideas or concepts.** In order to test the hypothesis of Goldschmidt and Tatsa (2005), we analyzed all concepts used in the studio and their links during the semester. We linked nodes of concepts that are reported together in the same submission (thus relating to a design stage) with edges in Cytoscape software. Edges are bundled using the built-in algorithm with the following parameters: spring constant (0.003), compatibility threshold (0.3), the number of handles (3), maximum iterations (100). With a network analysis, we achieved the rates of links between nodes. Figure 2 shows that concepts that have higher rates of connection and more links are gathered at the center, whereas concepts with fewer links are in the periphery. Additionally, high rated links are darker and thicker. Concepts with high rated links are used by more students and lead the main studio discussions.

**CONCLUSIONS**
We used the setting of an International Urban Architectural Design Master's Studio as a living laboratory and set an online research platform for collecting self-reports of students as an objective data. We evaluated the keywords of assignments submitted every two weeks during the semester as verbal conceptual representations of their works.

We analyzed verbal conceptual representations in design learning based on two hypotheses (Table 3). Our results indicate that it is possible to follow the im-

<table>
<thead>
<tr>
<th>Concept edges – Group Concept Couples and Student Concepts</th>
<th>Edge betweenness</th>
</tr>
</thead>
<tbody>
<tr>
<td>frontstage-sideline &lt;-&gt; backstage</td>
<td>36.00</td>
</tr>
<tr>
<td>frontstage-sideline &lt;-&gt; social resilience</td>
<td>21.00</td>
</tr>
<tr>
<td>frontstage-sideline &lt;-&gt; appropriation</td>
<td>21.00</td>
</tr>
<tr>
<td>frontstage-sideline &lt;-&gt; fragmented city</td>
<td>21.00</td>
</tr>
<tr>
<td>frontstage-sideline &lt;-&gt; collective space</td>
<td>21.00</td>
</tr>
<tr>
<td>foundspace-sterile space &lt;-&gt; informal activities</td>
<td>17.33</td>
</tr>
<tr>
<td>foundspace-sterile space &lt;-&gt; buffer zone</td>
<td>17.33</td>
</tr>
<tr>
<td>foundspace-sterile space &lt;-&gt; spaces of uncertainty</td>
<td>17.33</td>
</tr>
<tr>
<td>void &lt;-&gt; frontstage-sideline</td>
<td>16.83</td>
</tr>
<tr>
<td>acupunctural interventions &lt;-&gt; frontstage-sideline</td>
<td>16.83</td>
</tr>
</tbody>
</table>
Figure 2
Concept map of the whole studio: A force-directed graph drawing, generated through Cytoscape Software, using an SQL query from the database of the web platform containing student reports.
Table 3
The overall evaluation of hypothesis tests.

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Accept/Reject</th>
<th>Reference Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₁  Initial or early concepts provide a starting point for developing fully-fledged specialized design ideas.</td>
<td>Accepted</td>
<td>(Cross 2006, p.106)</td>
</tr>
<tr>
<td>H₂  Higher number of links indicate the criticality and importance of the ideas or concepts</td>
<td>Accepted</td>
<td>(Goldschmidt &amp; Tatsa 2005, p.603).</td>
</tr>
</tbody>
</table>

Implications of verbal concepts in the students’ design processes, and they demonstrate certain patterns:

1. Our network analysis (edge-betweenness centrality values) indicated that early concepts acted as a central reference to the whole studio.
2. Early concepts provided a starting point for developing fully-fledged specialized design ideas. For each student, the traces of the early concepts were visible in the final verbal logs of the students.
3. The most referenced verbal concepts by the students were critical and led the main discussions in studio.

By using a web-based research platform to collect self-reports of the students, it was possible to generate concept maps and statistics which helped to understand how students think conceptually and how concepts contribute to the design process.

Furthermore, in the studio, we observed the implications of verbal conceptual representations to design processes. We found that the verbal concepts introduced in the early stages of the design studio play a crucial role in the design processes of the students. From a pedagogical standpoint, we believe that discovering their effects on different phases can help to initiate and trigger new ideas to develop better designs in a studio setting. Our research is limited in scale and it is clear that there is a need for more in-depth research to reveal these effects. We hope that this study will be helpful to designers and researchers as a basis for understanding the role of the verbal concepts in design learning as well as a structured method for collecting, visualizing and analyzing the relations between the design concepts.

REFERENCES
Akin, O 1986, Psychology of Architectural Design, Pion Limited
Akin, O and Lin, C 1995, 'Design protocol data and novel design decisions', Design Studies, 16(2), pp. 211-236
Darke, J 1979, 'The primary generator and the design process', Design Studies, 1(1), pp. 36-44
Goldschmidt, G 2001 'Is a figure-concept binary argumentation pattern inherent in visual design reasoning', Proceedings of the Second International Conference on Visual and Spatial Reasoning in Design Computational and Cognitive Approaches, pp. 177-205
Goldschmidt, G and Sever, AL 2011, 'Inspiring design ideas with texts', Design Studies, 32(2), pp. 139-155
Goldschmidt, G and Tatsa, D 2005, 'How good are good ideas?', Correlates of design creativity. Design Studies, 26(6), pp. 593-611
Miller, GA 1956, 'The magical number seven, plus or minus two: some limits on our capacity for processing
information', *Psychological review*, 63(2), p. 81


