

THE USE OF METADATA AS A MEANS TO IMPROVE THE QUALITY OF DESIGN: RESULTS FROM EDUCATION

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Abstract. We present the results from the evaluation of the use of KeySet in the architectural BSc curriculum at Delft University of Technology. KeySet is a metadata system that provides data with a unique key consisting of a combination of keywords according to four dimensions. These dimensions constitute the qualities that data possess at different levels. In KeySet, assigning keywords to data is considered a form of claiming these qualities that the data possess.

1. Introduction

As part of an educational project to develop a learning environment to support group work and discourse, named InfoBase, we developed and implemented a metadata system named KeySet. This metadata system serves to provide each design product (e.g. model, image, text, picture, animation) with a unique key consisting of four or more keywords. KeySet defines four dimensions corresponding to which keywords are assigned as metadata to data. These dimensions constitute the qualities that the data possess at different levels. In KeySet, assigning keywords to data is considered a form of claiming. The four dimensions form as it were the space in which claiming the data takes place. These claims concern:

- the constructive qualities of the data, that is, the idea one tries to represent in the design;

- the objective qualities of the data, that is, the (f)actual elements that one uses to express this idea;
- the relational qualities of the data, that is, the influence the design has on the user and, vice versa, the influence of the user on the design;
- the subjective qualities of the data, that is, the emotion that the design elicits.

Technically, KeySet encompasses an entry form, used to compose the key, and a search tool that can retrieve all entered keywords and combinations of keywords in different ways for adaptation or reuse. Didactically, KeySet pushes students to deal with the paradox that a database is losing informative quality when it is cleared into a neat one. They learn that a certain measure of chaos lubricates the exchange of information and that, to be informative, a database has to cherish the differences that arise from the same assignment students get. Strategically, KeySet encourages students to learn from one another and work together as young professionals by providing them the opportunity to compare their work and design solutions directly.

We are embedding KeySet in the Bachelor program of the Architectural curriculum at Delft University of Technology, and we have started an extensive scales evaluation of the use of KeySet. In this paper, we present the most important results from this evaluation so far. We refer to Stouffs et. al. (2004) for a more in depth explanation of the use of metadata for formalizing the process of laying claims and of the KeySet metadata system and its application in the educational curriculum.

2. Scale Evaluation

The evaluation of the use of KeySet and the InfoBase environment in which it is embedded is carried out as part of a longer-term international research into the use of computers in learning situations. The evaluation concerns the use of ICT in general and the use of KeySet as an instrument to assign metadata in particular. This research is conducted by means of two scales: the Subjective Computer Experience Scale (SCES) and the Subjective E-platform Experience Scale (SEES). These scales are designed to measure the attitude and experience with respect to computer use (SCES) and the use of ICT as work and learning environment (SEES) (Kooistra et. al., 2004).

SCES is an internationally validated scale. It measures subjective computer experience, which can be described as “a private psychological state reflecting the thoughts and feelings a person ascribes to some existing computer event” (Smith et. al., 2000). SEES is a scale that we designed and tested ourselves in previous research. It measures the subjective assessment of experiences with ICT applications in education (the KeySet section of the scale measures the subjective assessment of experiences with KeySet applications in education). The measuring was repeated

before and after a second semester computer modeling workshop.

Specifically, KeySet was linked to the submission of student work for this workshop. About 300 students took part in the workshop in which they needed to model a constructive detail of an existing building. The submission requirements for this model were three elevation and two perspective view images. To each image they were required to assign metadata. For each dimension, a short list of keywords was specified from which the student could make a selection. Only for the relational quality dimension, a fixed claim “reference detail for architects and building specialists” was selected for all images. The students that took part in this workshop had been introduced in the previous (semester’s) workshop for the first time to the InfoBase environment and to the assignment of metadata according to the four dimensions, but not explicitly to the KeySet instrument. As such, some foreknowledge was present, which made it worthwhile to actually carry out two measurements. The first measurement yielded 157 useable forms, the second measurement 111.

2.1. SCES SCALE

SCES is an internationally validated scale and contains 25 items that are distinguished corresponding to five factors: *frustration*, *persistence*, *enjoyment*, *negative self-efficacy* and *training*. The measuring takes place on a five-point Likert scale, extended with the option ‘not applicable’. *Frustration* indicates the amount of frustration/annoyance of the user; *persistence* points to the need for autonomy (figuring out oneself how it works); *enjoyment* means the fun the user has in it; *negative self-efficacy* indicates the negative self-image of the user (the extent to which he or she thinks that others are better with the computer); *training* points to the need for instruction. Note that in every evaluation using SCES, the reliability (Crombach’s Alpha) is measured anew and the result is compared with previously found values. In the case of this architectural research too, SCES has been determined to be a reliable instrument and the values correspond to previous ones (InfoBase, 2004).

2.2. SCES RESULTS

We compare the average values measured for each of the SCES factors in the first and second evaluation (for a more complete overview of the results, see Kooistra et al., 2005). These scores are satisfactory; the architecture student apparently knows how it is to work with computers. There is a certain longing for autonomy (*persistence* from 2.86 to 2.93, where three corresponds to the middle of the five-point scale) next to a somewhat bigger need for instruction (*training* from 3.38 to 3.46). There is frustration. Working with computers always means frustration. These things are after all sensitive to malfunctions and impose a template within which one needs to work; programs simplify things often unnecessarily. Nevertheless,

frustration decreases (from 3.45 to 3.31) and also peaks less (the spread decreases from 0.859 to 0.778). The negative self-image is stable (the other is better on the computer; from 3.33 to 3.36). But the values are lower than we have found elsewhere. That means that this architectural student population knows rather adequately what to do with oneself on the computer.

The values can be translated to a total score for the ‘average positive subjective experience for working with the computer’. In this case, a number of scores are recoded. These total scores amount for the architectural group to 3.26 (measurement 1) and 3.25 (measurement 2). It is stable. Important here is the spread, which decreases from 0.46 to 0.41.

2.3. SEES ICT AND KEYSSET

The SEES ICT scale contains 24 items that are distinguished corresponding to three factors that in their mutual combination represent the subjective assessment of experiences with ICT applications in education (Kooistra et al., 2004). These are the factors *confidence*, *worthwhile* and *liking*: *confidence* means to be familiar with the use of the instrument or program; *worthwhile* indicates the extent to which one finds the instrument or program worthwhile; *liking* concerns the fun that one has in using it (‘is it fun too?’). The measuring takes place on a five-point Likert scale, extended with the option ‘not applicable’. For the evaluation of the KeySet instrument, the structure of this scale is transferred to 24 items on KeySet, measuring the same factors (*confidence*, *worthwhile* and *liking*) with respect to KeySet.

2.4. SEES RESULTS

The scores for *confidence*, *worthwhile* and *liking* with respect to ICT are high (for a more complete overview of the results, see Kooistra et al., 2005). One is familiar with it and finds it worthwhile and rather fun too. In comparison to ICT, the scores on KeySet are on average one point lower. From the first measurement to the second, the picture is stable with a light improvement. The factor *confidence* increases; one becomes more familiar. That is good. The factor *worthwhile* also increases for many items. The factor *liking* stays behind, both with respect to ICT and KeySet. It remains work and study as usual for the students. Here too, it is important to note that the spread decreases all along the line. The usage stabilizes.

2.5. SEES ICT AND KEYSSET CORRELATIONS

Very strong correlations exist among the SEES ICT factors and among the SEES KeySet factors. That means that whomever scores highly (respectively, lowly) on one of the ICT factors (*liking*, *confidence*, *worthwhile*), also scores highly (respectively, lowly) on the two other factors. The same applies for KeySet.

Furthermore, strong correlations exist between the respective ICT and KeySet factors. Whoever scores highly/lowly on the ICT factors (*liking*, *confidence*, *worthwhile*), also does so on the corresponding KeySet factors. In addition, clear (though somewhat less strong) correlations exist among the various factors. Someone who is well/not familiar with ICT is not only well/not familiar with KeySet but also finds KeySet well/not fun and well/not worthwhile. In the first measurement, this picture predominates. It shows that students initially were guided by their experiences with ICT when scoring the KeySet items. In the second measurement, this picture is revised. The correlations among the ICT factors and among the KeySet factors remain entirely (though slightly less strong) while a number of correlations between ICT and KeySet factors strengthen or just disappear. The chance that someone who finds ICT well/not worthwhile also finds KeySet well/not worthwhile remains significant but the chance that he or she also finds it fun is reduced to mere coincidence. All in all, this makes the research more valid. The assessment of KeySet comes to stand more on its own and the values that we find make it possible to develop a strategy that specifically concerns KeySet.

These correlations clear the path for a strategy to improve the use of ICT and KeySet separately and in mutual combination. When one makes the students more familiar, the other factors will follow. When one makes it more worthwhile for them, the same happens. When one makes it more fun, ditto. Furthermore, the *variance analysis* we conducted has demonstrated that the factors *liking* and *worthwhile* more or less behave as the same factor and clearly differentiate themselves from the factor *confidence*. This clarifies the strategy that needs to be followed. Make students more familiar with dealing with metadata (KeySet) and they will find it worthwhile and maybe also fun. The latter not only depends on whether the instrument is profiled appropriately but also on the workshops in which it is included.

3. Supplementary evaluation

At the time of the second measurement, the students were also presented with a short questionnaire on the use of metadata (KeySet) when submitting one's work and searching for designs of other students. Primarily, we wanted to evaluate whether the students understood the purpose of the KeySet instrument. We can conclude that they did (see Table 1).

TABLE 1. Results from the short questionnaire supplementing the scales evaluation.
117 students completed this questionnaire.

Question	Percentage of answers			
	yes	somewhat	no	-
Was the instructor’s explanation clear?	39%	38%	17%	6%
Do you understand what is meant with each of the four dimensions?	55%	33%	7%	5%
Do you understand why these metadata must be assigned to the design?	54%	25%	12%	9%
Were the metadata useful when searching for work of others?	33%	33%	22%	12%
Did you find the search task useful?	9%	44%	39%	8%

The questionnaire also included an open question: “What did you get from looking at the work of others?” One hundred students answered this question. These answers can be divided into five categories: gaining inspiration or ideas, comparing results, (precedent) learning, nothing or not much, and others. Fourteen students said to be inspired by others or to have gained ideas. More than double indicated to compare oneself with others in terms of pace or level, e.g. “I’m noticeably lagging behind,” “I must work more precisely” or “ I saw that others may have modelled more beautifully, but my work was OK”, More than a quarter of the students indicated what they had learned from it, e.g. “I have learned that gothic details exist and that these can form a ‘quatroknoop’,” “I found out that few selected window frames” and “looking how they constructed the different encounters.”

Finally, there were a number of answers that directly substantiated our didactic objectives, e.g. “More insight, because you want to know why exactly they assign specific claims to their detail. You start reading these details better”, “You see how many different types of details can be found with the same keywords”, also “It is difficult to find a reference through the claims because everybody describes their detail very differently” and finally “A feeling of solidarity with my fellow students and curiosity as to what they are busy with.” Even the fact that students had difficulty finding anything still offers clues, e.g. “my detail had a different context, there you go with your keywords” and “not so much, with the keywords I tried to find a detail that was similar to mine and I couldn’t find it.”

Conclusion

InfoBase is a technically advanced database. The addition of the KeySet instrument to InfoBase gives the database extra dimensions. It makes InfoBase into both a

didactic and strategic instrument. Didactically, InfoBase with KeySet is well equipped to teach students what it means to share information, to handle metadata and to understand chaos and order in their combination as essential factor for the information content in a database. Strategically, InfoBase presents a very interesting link between education and profession. The fact that students learn to share information in a professional way during their education, enables them to continue this (academic) attitude in the architectural discourse upon graduation as a professional (alumnus).

The correlations found between the SEES ICT and KeySet factors and the variance analysis conducted has clarified the strategy that we think that needs to be followed. Make students more familiar with dealing with metadata (KeySet) and they will find it worthwhile and also rather fun. The latter not only depends on whether the instrument is profiled appropriately but also on the courses or workshops in which it is included. As such, it also depends on a stimulating policy of the Faculty.

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