Knowledge Acquisition and Opinion Formation in Science Museums: The Role of a Discussion Terminal for Collaborative Elaboration on Controversial Issues

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Abstract: Today, science museums are often challenged by having to present highly controversial issues. Beyond presenting objects, facts and figures, the museums have to provide visitors with the opportunity to participate in public debates about those issues. In this paper we present a project that focuses on the potentials of discussion terminals for this purpose. A study was designed to investigate whether a discussion terminal for asynchronous communication among museum visitors can support deep elaboration of controversial information and formation of well-founded opinions in visitors. More specified, the salience of relevant arguments and active expression of one's own opinion are expected to result in deeper elaboration of content and higher degrees of learning. Additionally the study investigates the impact of other visitors' opinion on learning and opinion formation. Social comparison processes can stimulate elaboration of arguments and the development of visitor's own well-founded opinions. It is assumed that salience of arguments, active positioning, and social comparison are crucial factors for both learning and opinion formation. Elaboration of information should be deeper when arguments are salient and active positioning is possible. Social comparison should stimulate elaboration of arguments and evaluation of visitors' own opinion if a cognitive conflict between one's own opinion and others' opinion is elicited. Depending on salience of arguments and on individual variables our participants should use simple cognitive strategies like assimilation or real knowledge building activities on condition of inconsistent feedback about others' opinions. Attitudes that are based on more information are more stable in time. When people are actively engaged in judging a controversial topic, relevant knowledge should be better and more accessible than for people who only visited the exhibition passively as recipient of information.

Extended summary: This study follows fundamental research on elaboration on controversial information and opinion formation on ambivalent topics which is considered as important (learning) goal not only at school but also in informal learning settings like science museums (Anderson, 1991; Broemer, 1998; Chan, Burtis, & Bereiter, 1997; Van Harreveld, Van der Pligt, De Vries, Wenneker, & Verhue, 2004). Most current science topics (like gene technology, nanotechnology) share the characteristics of being ambiguous and ambivalent. Hence, science museums are often challenged to present the controversy of these topics and to support visitors in developing reflective and critical thinking. It is assumed that such 'opinion formation' can only be accomplished if visitors are engaged in deep elaboration of relevant arguments and actively participate in (public) debate. Particularly, discussion in museums should foster reconsideration and hypothesising about exhibits. Therefore, the integration of an asynchronous discussion terminal should enhance learning and opinion formation.

In our study a computer-mediated asynchronous discussion terminal is designed to mediate and encourage elaboration and opinion exchange on the topic of nanotechnology. Ss visiting the exhibition "nanodialogue" have the opportunity to engage in an asynchronous 'debate' with other visitors. Three types of cognitive mechanisms are assumed to lead to deeper elaboration of content when visitors interact with the discussion terminal:

1. *Active participation and involvement.* Involvement is regarded as crucial factor influencing whether information is processed systematically or peripherally. The discussion terminal increases visitors' involvement by asking for their personal opinion and challenging this opinion by social comparison. Articulating one's personal opinion results in higher motivation and involvement and also supports reflection and abstraction (Petty & Cacioppo, 1986; Reimann & Zumbach, 2001; Spies, 1994).
2. *Salience of multiple perspectives.* According to social comparison theory, people tend to evaluate their own opinions; they gain the most useful information whether their opinion is appropriate by using similar others as models (Festinger, 1954; Suls, Martin, & Wheeler, 2004). Therefore, the impact of other visitors' opinion on learning and opinion formation will be considered. Reading others' statements makes controversy salient and multiple perspectives give rise to further reflection of one's own understanding via comparisons with other visitors' opinions.
3. *Resolving cognitive conflict.* An awareness tool is implemented that summarizes others' opinions and displays one's own opinion in comparison to theirs (see fig. 1). By conflicting feedback, cognitive conflicts

are elicited and resolving these conflicts requires deeper elaboration of content (Buchs, Butera, Mugny, & Darnon, 2004; Chan, Burtis, & Bereiter, 1997; Lowry & Johnson, 1981).

Fig. 1: Social comparison by feedback about others' opinion and opinion exchange.

Further research on opinion formation in gene technology indicates that people rely on general attitudes when they are asked to judge a specific topic (Keck, 1998; Scholderer, 2004). This goes in line with dimensional models of attitude formation proposing a top-down-process (e.g., Sherif & Sherif, 1967). Such top-down processes of attitude formation often result in inadequate, unsophisticated attitudes because specific argumentation is not considered. A bottom-up process based on single beliefs and integration of (controversial) information into an overall judgement seems more adequate as they result in well-founded opinions (belief-based model of attitude formation, Rosenberg, 1956). A main objective of our discussion terminal is thus to support bottom-up processes of opinion formation. This goal is realized in our study by increasing the salience of available arguments.

On basis of these theoretical considerations it is assumed that the implementation of such a discussion terminal is beneficial for knowledge acquisition and opinion formation. Therefore, our main research questions are:

1. Does *salience of relevant arguments* and *expressing one's own opinion* enhance elaboration and opinion formation about controversial issues?
2. Can *availability of social comparison information* foster cognitive elaboration of arguments?

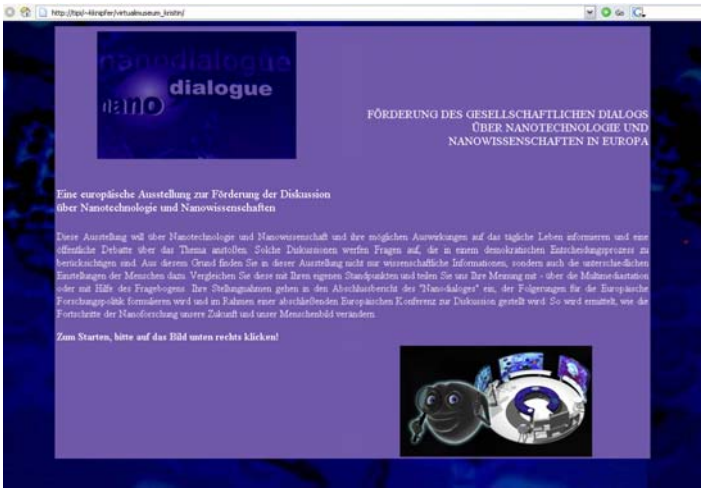

Fig. 2: The virtual exhibition about nanotechnology.

A "virtual museum" about nanotechnology is used in our study to collect data under controlled conditions (see fig. 2). 20 participants are randomly assigned to eight conditions, thus data of 160 persons will be collected. Participants in our study can explore the exhibition without constraints and time pressure. Afterwards, they explore the discussion terminal: In the condition of salience of arguments participants are asked to assign eight statements to experts (cond. 1) or rate these statements and nanotechnology in general by acceptance and relevance and additionally type their own statement (cond. 3). One group only advances an opinion about nanotechnology in general (cond. 2). The control group works on a quiz about nanotechnology. Additionally, feedback about other participants' opinions is available after the individual rating activity on condition of active positioning. In this study, this feedback is systematically varied as a) consistent (cond. 4/5) or b) conflicting with Ss' own opinion (cond. 6/7; see table 1).

Table 1: Research design

		Active positioning of the visitor			
		no	yes		
			Social comparison information		
			neither	consistent	conflict
Salience of arguments	no	control group	condition 2	condition 4	condition 6
	yes	condition 1	condition 3	condition 5	condition 7

After the "museum visit" participants are asked to complete a knowledge test and to write a short essay about nanotechnology which includes all arguments they remember from their museum visit. Also, visitors' statements will be analysed to assess quantity and quality of argumentation and the extent of referencing to other visitors' and expert statements. Log-files and verbal protocols collected during exploration will give insight on cognitive elaboration processes.

It is assumed that salience of arguments and active positioning are crucial factors for both learning and opinion formation. Elaboration of information should be deeper when both factors are implemented. Social comparison should stimulate elaboration of arguments and evaluation of visitors' own opinion if a cognitive conflict between one's own opinion and others' opinions is elicited. Dependent on salience of arguments our participants should show simple cognitive strategies like assimilation or real knowledge building activities on condition of inconsistent feedback about others' opinions. Participants of condition 6 should therefore show best results in the knowledge test and in remembering relevant arguments and have more sophisticated opinions about nanotechnology.

This study will be conducted in January 2007. Results of the main study will be presented at the EARLI conference in autumn 2007.

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