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Novelty at a mobile laboratory: Pilot study results

The mobiLLab high-technology mobile learning laboratory was developed by the University of Teacher Education in St. Gallen to pique the interest of Switzerland's youth in science and technology (S&T) topics and careers. Existing studies show that while visits with science centers and mobile laboratories sometimes result in positive changes in pupils' S&T interest and knowledge immediately after a visit, changes fade after one or two months (Barmby, 2005; Jarvis, 2005; Brandt et al., 2008; Pawek, 2009; Dowell, 2011; Gassmann, 2012; Sasson, accepted in 2014). Investigation of mobiLLab's effectiveness should dig deeper into possible impact factors uncovered by these studies such as classroom preparation and familiarity with informal learning settings.

A framework for studying novelty at high technology informal learning places

Several existing frameworks for investigating out-of-school learning places (OSLePs) suggest that unfamiliarity is a barrier to learning and interest development. However, these models, such as Orion and Hofstein's (Orion, 1993; Orion & Hofstein, 1994) novelty space theory, are designed for field trip experiences and do not address the particular case of a high-technology laboratory. Therefore, a modified novelty space model was developed based on three factors thought to be most influential on pupils' experience: whether they tinker or seek direction when working with technology (capability dimension), previous experiences with OSLePs (setting dimension), and previous S&T knowledge (cognitive dimension).

Study design for a mobile laboratory

The mobiLLab program brings experiments to secondary schools in the German speaking part of Switzerland. During a typical visit, 14- to 16-year-olds spend a morning or afternoon at four of twelve experimental posts, at which they work in pairs with no frontal instruction. A background investigation of the mobiLLab program, including a literature review (Cors, 2013), indicated priority factors to investigate were classroom preparation, novelty and teacher attitude and how they affect pupils' S&T attributes: interest, attitude and self-concept. A mixed-methods investigation was designed to explore the question, 'How do differences in pupil novelty space and pre-visit activities explain variations in pupils' S&T attributes?' Treatment teachers received additional preparation materials, so that their preparations would vary from that of control group teachers. Relations between preparation and novelty factors (independent variables (IVs)) and pupil attributes (dependent variables (DVs)) were explored through a multivariate analysis of variance (MANOVA) statistical test. By creating a summary DV, MANOVA controls for Type I (false positive) error inflation that comes with repeated statistical tests on individual DVs; the test also identifies interactions between multiple IVs.

Results

Pilot data collection in Spring 2014 involved 9 teachers and 15 of their class groups who experienced a mobiLLab visit. Teachers and pupils completed pre- and post-visit surveys and investigators conducted mobiLLab school visit observations and interviews with all 9 teachers. 208 pupils responded to both pre- and post- surveys (108 male; 97 female; 3 no

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response). Using a scale of 1 (never true) to 4 (always true), pupils indicated a somewhat strong tendency to tinker, a very positive perception of their teachers' interest in S&T and somewhat positive S&T attributes. From pre- to the post-survey, interest and self-concept for both technology and for natural science showed small significant decrease (effect sizes, given as Cohen's d, were 0.18 or less), while changes in attitude were not significant (ns).

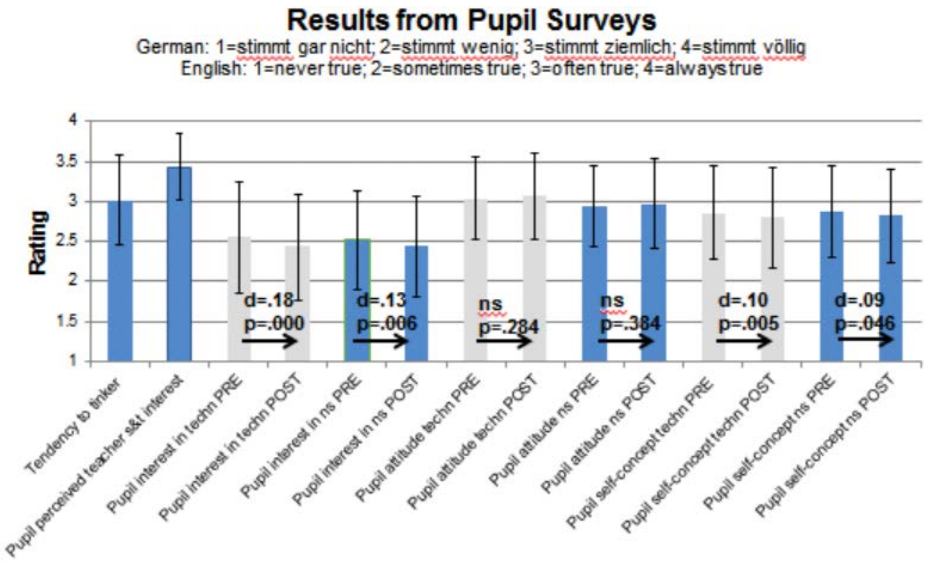

Figure 1: Pupils' tendency to tinker, perceived teacher interest and S&T attributes.

Factors found to significantly affect pupils' S&T attributes are shown in Table 1 below. The magnitude to which each factor explains the variation between two groups, such as between boys and girls, can be roughly interpreted using Cohen's (1988) benchmarks for partial eta squared: small (η_p^2=.01), medium (η_p^2=.06) and large (η_p^2=.14). Results suggest that pupils, who had more positive S&T attributes, were most often boys who tended to tinker, had more experiences with informal learning settings, had higher grades and had experienced a longer preparation (between-group comparison). Changes in pupils' S&T attributes from the pre- to post-visit surveys could be explained by whether or not pupils tended to tinker and differences in classroom preparation time (within-subject changes).

Factors with insignificant effects were how oriented pupils felt for the visit, how engaged pupils were at the visit, perceived importance of learning goal, type of post-visit task pupils completed, the experimental posts pupils worked and perceived teacher interest in S&T.

Discussion and Implications

MANCOVA results indicate that gender, grades and novelty factors, particularly pupils' tendency to tinker, are strong predictors of pupils' S&T attributes. Similarly, data from teacher interviews suggest that pupils' comfort with mobiLLab experimental equipment affects their ability to engage in and profit from a mobiLLab visit. Based on these results, a main study will be designed to focus on novelty space factors. A better understanding of pupils' novelty experiences at the mobiLLab visit, such as how comfortable pupils are with mobiLLab experimental equipment, will add depth to the study. Studies of high-technology OSLePs need to examine orienting and capability factors, which affect how well pupils engage in these experiences and develop a momentary, situational interest, which, in turn, can contribute to a lasting shifts in dispositional interest.

Table 1: Factors that significantly affect pupil S&T attributes: interest, attitude, self-concept

Factor (Independent Variable)	Pupils' technology attributes				Pupils'natural science attributes			
	df	df error	F	η_p^2	df	df error	F	η_p^2
Between-group comparisons: multivariate effects ($p<0.05$)								
Tinkers vs seeks direction	3	197	32.3	.34	3	195	13.0	.17
Experience: techn OSLePs	3	195	25.1	.28	3	193	11.4	.11
Experience: n.sci. OSLePs	not significant				3	193	8.3	.15
Math grades	3	195	4.0	.06	3	193	5.2	.07
Science grades	3	194	4.2	.06	3	192	11.0	.15
Preparation type	9	566	4.2	.06	9	467	2.2	.03
Gender	3	191	25.4	.29	3	189	5.7	.08
Perceived peer interest	3	191	4.4	.06	not significant			
Within-subject changes from pre-to post-survey: multivariate effects ($p<0.05$)								
Tinkers vs seeks direction	3	197	3.4	.05	not significant			
Preparation type (time)	not significant				9	462	2.4	.03

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