



Interests, Attitudes and Beliefs Concerning Science Education Topics amongst Kindergarten and Primary School Trainee Teachers

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Abstract

According to various studies, personal factors such as interest, attitudes and self-efficacy beliefs are important in influencing teachers' motivation to teach science subjects in kindergarten and primary school [1; 2]. For this study, a sample of female first year students in the kindergarten and primary school teacher training programme at University of Teacher Education Bern was analysed. A questionnaire [3] was used to survey how students rate different areas of natural and social science subjects (social/ethical, cultural/religious, historical/political, physical/technical, geographical, economical, biological), which constitute the official subject "nature – human – society" in Switzerland's primary schools. In the second part of the questionnaire, students had to rank the curricula contents of the subject "nature – human – society" according to their own individual preferences. In the third part, they had to rate different learning activities. Next to this questionnaire, the German version of AIST [4], which detects more general areas of interests in the sample, was applied.

Results show that biology and physics/technology are positioned on opposite ends of a large spectrum of interest in social and natural science areas. All other subject areas are positioned in-between.

Keywords: *trainee teachers, natural sciences, motivational orientation*

1. Introduction

In Switzerland's kindergarten and primary school, "nature – human – society" (NMG) is a holistic subject including contents from disciplines of the natural and social sciences. Kindergarten and primary school teachers attend a generalist training and have to teach each of these contents [3], but these contents aren't equally popular with different teachers. A survey of primary school teachers in all cantons of Switzerland revealed that the ten most popular topics for them to teach in the first and second grade of primary school all belong to the content areas of the planet earth, animals, habitats and living communities. In contrast, the topics of electricity and magnetism represent the most unpopular contents to teach in the subject "nature – human – society". Teachers' personal preference in contents seems to have an influence on their lessons: The Swiss HarmoS-study shows that in the teaching practice of natural sciences as a part of the "nature – human – society" education, inanimate phenomena and technology are underrepresented. Teachers dedicate science teaching time mainly to topics concerned with plants, animals and habitats [5]. Studies on German primary schools yielded similar results, showing that biological contents are more common than physical or chemical contents [1; 6]. A reason for this imbalance in science teaching could be the motivational orientation of the teachers [1; 2]. In general, primary school teachers have a reserved attitude towards physics, which is evident in a low interest and a low academic self-concept in physics, whereas their motivational orientation in the field of biology is distinctly positive [7; 1]. This statement is also valid for kindergarten teachers: Their interests correlate positively with their academic self-concepts in natural science areas and their didactic self-concepts in teaching them [2]. Nevertheless, German kindergarten and primary school teachers tend to value the importance of natural science education in kindergarten and primary school [1; 2]. Trainee teachers often justified their different preferences for science areas by citing the relevance they ascribed to the sciences for the lifeworld [8].

One aim of this study is to investigate and illustrate the quantitative characteristics of interests, attitudes and beliefs in natural and social sciences in kindergarten and primary school trainee teachers in an exploratory way. Also important are learning activities and approaches to the different disciplines. A second aim of the study is to identify variables that can be used to predict whether or not a trainee teacher likes teaching a natural science subject. These variables are tested in a model.

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2. Methods

2.1 Participants

Subjects were recruited at the University of Teacher Education Bern. The sample includes all female subjects which attend the first year of the kindergarten and primary school teacher training programme.

2.2 Measurement

The survey is composed of demographic questions about the former education of participants. Next to those, a questionnaire [3] which deals with learning and teaching in NMG-subjects was distributed. In the first part, participants have to rate 10 statements about seven perspectives in NMG-subject (social/ethical, cultural/religious, historical/political, geographical, economical, physical/technical, biological). Each perspective is divided into a scale called "affection", meaning their interest in, positive experience of and affinity to a specific perspective, and a scale called "self-concept", which detects competences related to the specific perspective. One item records the importance and relevance of the seven perspectives in daily life. In the second part of the questionnaire, participants rank the curricula contents of the subject "nature – human – society" according to their individual teaching preferences. These contents are assigned to a science subject (e.g. physics, chemistry, biology). The third part of the questionnaire consists of singular items to different learning activities, which participants have to rate.

The scales of the questionnaire are standardized and validated with the AIST-questionnaire [4]. The AIST is composed of 6 scales, which collect data dealing with general interests (realistic, investigative, artistic, social, enterprising, conventional).

3. Results

3.1 Sample

The sample consists of 159 female kindergarten and primary school trainee teachers. The average age of subjects is 21,40 (SD=3,12) years. Before starting the teacher training programme, 8 (7,4%) received a physical/technical/biological education and 100 (92,6%) did not.

3.2 Reliability and Validity

For each scale, a Cronbach's alpha was calculated. Values for affection scales range from .83 to .86 and for self-concept scales from .82 to .88. The affection scales and the self-concept scales from each perspective were validated with the AIST scales. Table 1 lists which scales correlate significantly.

Table 1. Correlation between affection scales of NMG-perspectives and AIST scales

Affection scales of NMG-perspectives	AIST scales
social/ethical ($\alpha = .825$)	<ul style="list-style-type: none"> ▪ social ($r = .436$; $p < .001$) ▪ artistic ($r = .314$; $p < .01$) ▪ enterprising ($r = .304$; $p < .05$)
cultural/religious ($\alpha = .851$)	<ul style="list-style-type: none"> ▪ artistic ($r = .349$; $p < .01$)
historical/political ($\alpha = .832$)	<ul style="list-style-type: none"> ▪ n.s.
geographical ($\alpha = .860$)	<ul style="list-style-type: none"> ▪ investigative ($r = .254$; $p < .05$)
economical ($\alpha = .857$)	<ul style="list-style-type: none"> ▪ investigative ($r = .276$; $p < .05$)
biological ($\alpha = .848$)	<ul style="list-style-type: none"> ▪ n.s.
physical/technical ($\alpha = .856$)	<ul style="list-style-type: none"> ▪ investigative ($r = .564$; $p < .001$) ▪ realistic ($r = .344$; $p < .01$).

3.3 Descriptive Statistics

Trainee teachers showed the highest average on biological and social/ethical perspective and the lowest on economical and physical/technical perspective. This pattern was evident for the affection scales and academic self-concept scales alike (see figure 1).

The most popular content to teach for 40 (25,2%) trainee teachers was from the field of sociology, for 30 (18,9%) from the field of biology and for 28 (17,9%) from the field of geography. The most



unwelcome content to teach for 60 (37,7%) students was from the field of physics, for 38 (23,9%) from the field of chemistry, and for 13 (8,2%) from the field of astronomy. 66 (41,5%) persons stated that biology is their favourite or second favourite subject to teach, 17 (10,7%) chose physics or chemistry. The activity which was rated highest was “to experience something” (M=2,71; SD=0,50), followed by “to test/experiment something” (M=2,50; SD=0,66) and “explore something for himself/herself” (M=2,38; SD=0,65).

At the importance/relevance items, the social/ethical area yields the highest median (Md=5) and the physical/technical (Md=3) and geographical (Md=3) yield the lowest ones on a five-point Likert scale.

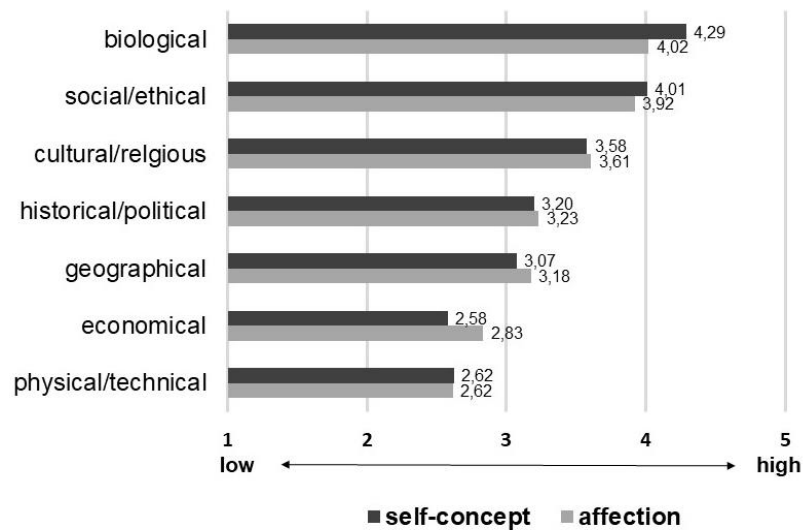


Fig. 1. Average scores of self-concept and affection scales for all perspectives

3.4 Differences between groups

In this part, I describe the differences between trainee teachers who like teaching natural science subjects (physics/chemistry respectively biology) and those who do not (see also table 2).

Subjects who like teaching physical or chemical contents obtain higher scores for the activity item “measuring, counting, sorting” (Mann-Whitney-U=843,500; $p < .05$), and lower scores for “arguing and developing ideas” (Mann-Whitney-U=791,000; $p < .05$) and “expressing and inserting their own recommendations” (Mann-Whitney-U=866,500; $p < .05$). Regarding the self-concepts, they achieve a significantly higher score on the physical/technical scale (Mann-Whitney-U=717,000; $p < .01$) and lower scores on historical/political (Mann-Whitney-U=757,000; $p < .05$) and cultural/religious (Mann-Whitney-U=782,000; $p < .05$) scales. If we look at the affection scale, we find lower scores in the social/ethical (Mann-Whitney-U=856,500; $p < .05$) and the cultural/religious (Mann-Whitney-U-Test=782,000; $p < .05$) and higher scores in the physical/technical (Mann-Whitney-U=677,000; $p < .05$) perspective. On the importance/relevance items, they score significantly lower in social/ethical (Mann-Whitney-U=905,500; $p < .05$), historical/political (Mann-Whitney-U=858,000; $p < .05$) as well as in economical perspective (Mann-Whitney-U=852,000; $p < .05$).

Subjects who like teaching biological contents achieve significantly lower scores for “arguing and developing ideas” (Mann-Whitney-U=2240,500; $p < .01$) as well as “expressing and inserting own recommendations” (Mann-Whitney-U=2450,000; $p < .05$). They get significantly lower scores in cultural/religious self-concept scale (Mann-Whitney-U=2426; $p < .05$). Regarding affection, trainee teachers who like teaching biology score significantly lower on the social/ethical (Mann-Whitney-U=2145,500; $p < .01$) and the cultural/religious scale (Mann-Whitney-U=2124,000; $p < .01$). On the importance/relevance items, they obtain a very significantly lower score on social/ethical item (Mann-Whitney-U=2307,500; $p < .01$).



Table 2. Group-Differences (favourite/not favourite subject to teach “physics/chemistry” and “biology”)

	Teaching physics or chemistry			Teaching biology		
	favorite (N=17)	non favorite (N=142)	Mann-Whitney-U; p	favorite (N=66)	non favorite (N=93)	Mann-Whitney-U; p
	middle rank	middle rank		middle rank	middle rank	
preferred activities	measuring, counting, sorting	101,38	77,44	84,39	76,89	2779,500; n.s.
	arguing and developing ideas	55,53	82,93	67,45	88,91	2240,500; P < .01
	expressing own recommendations	59,97	82,40	70,62	86,66	2450,000; p < .05
self-concept	planning, designing and presenting to test/experiment something	79,35	80,08	75,10	83,48	1196,000; n.s.
	physical/technical	91,53	78,62	85,56	76,05	1011,000; n.s.
	biological	108,82	76,55	86,93	75,08	717,000; p < .01
affection	social/ethical	77,79	80,26	88,34	74,08	1169,500; n.s.
	cultural/religious	53,38	82,47	72,00	85,68	856,500; p < .05
	physical/technical	53,53	83,17	86,91	70,26	782,000; p < .05
importance	physical/technical	111,18	76,27	82,08	78,53	677,000; p < .01
	biological	82,94	79,65	90,78	72,35	2357,500; p < .05
	social/ethical	51,88	83,37	66,01	89,93	2145,500; p < .01
	cultural/religious	58,82	82,54	65,68	90,16	847,000; p < .05
	physical/technical	82,50	79,70	78,89	80,79	1164,500; n.s.
	biological	68,68	81,36	79,42	80,41	3030,500; n.s.
	social/ethical	62,26	82,12	88,19	68,46	905,500; p < .05
	cultural/religious	64,68	81,83	73,38	84,70	2632,000; n.s.
	historical/political	59,47	82,46	75,72	83,04	2786,500; n.s.
	geographical	72,62	80,88	85,55	76,06	1081,500; n.s.
	economical	59,12	83,50	80,91	79,35	3009,000; n.s.

3.5 Regression Analyses

Logistic regression analysis was carried out with the dependent variables “favourite subjects to teach” physics or chemistry (N=17) and biology (N=66). Variables were included as predictors, showing significant differences between the two levels (my favourite subject/not my favourite subject). For the dependent variable “physics or chemistry” variance explanation is from .19 (Cox & Snell R²) up to .39 (Nagelkerkes R²). The variables “self-concept: physical/technical” (OR=4,512, p<.01) and “importance: social/ethical” (OR=.368; p<.10) can be used to predict the dependent variable significantly, “measuring, counting, sorting” (n.s.) as well as “affection: social/ethical/cultural/religious” (n.s.) cannot. For the dependent variable “biology”, variance explanation ranges from .17 (Cox & Snell R²) up to .23 (Nagelkerkes R²). The variables “thinking, arguing and developing ideas” (OR=.505; p<.05) and “affection: social/ethical/cultural/religious” (OR=.407; p<.05) can be used to predict the dependent variable significantly, “self-concept: cultural/religious (n.s.)” and “importance: social/religious” cannot.

4. Discussion

The data demonstrates that high interests, positive attitudes and self-efficacy beliefs concerning biological and social/ethical topics are prevalent in trainee teachers. Very few trainee teachers identified science subjects like chemistry or physics as their favorite subject to teach. In concordance, affection, importance and self-concept in the physical/technical area are assigned to the lowest values. The self-concept in physical/technical perspective shows a clear distinction between trainee teachers who likes teaching physical and chemical contents and those who do not. This result is influenced in part by the previous education of trainee teachers: those who attended a high school with a natural science or a technical focus scored higher than the others. Furthermore, trainee teachers who like



physics and chemistry as a subject to teach indicate a lower interest in social/ethical and cultural issues.

An analysis of the distribution of the different perspective scales shows a poor variance on the scales biological and social-ethical. On the one hand, this means that trainee teachers consistently appraise these perspectives but on the other hand, the poor variance in the data leads to the difficulty of finding significant correlations or differences. In contrast, the unpopularity of physics and chemistry leads to a very small sample of persons who like to teach these subjects, which increases the probability of sampling errors, if between-group analyses were performed. Therefore, more trainee teachers should be recruited for the study, to enhance the validity of differences.

A consequence of this study for school and teacher training could be to improve students' competences in physics and chemistry in order to strengthen their academic self-concept. In order to increase interest in physics and chemistry, it seems important to contextualize this knowledge and to show that it is part of human culture, as well as meaningful in the lifeworld.

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