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Differences between boys and girls in extracurricular learning settings

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Only few psychological differences between the sexes can be proven empirically. Presented here is a study about learning in the extracurricular environment of a zoological garden during a school excursion with particular regard to the differences between boys and girls. In the main focus are, hereby, motivational and cognitive levels of the aforementioned learning situation. A pre/post-test design was conducted with 223 fifth graders of the highest stratification level (Gymnasium). Girls showed a higher degree of intrinsic motivation and also had statistically significant more knowledge gain in the subscale of open-ended knowledge-items. The results are discussed within the framework of the Contextual Model of Learning.

Keywords: contextual model of learning, extracurricular learning, gender, intrinsic motivation

Introduction

In recent years the specifics of extracurricular learning became a focal point of educational research as special issues in the *Journal of Research in Science in Teaching* (Feher, & Rennie, 2003), in *Science Education* (Dierking, Ellenbogen, & Falk, 2004) and in *Unterrichtswissenschaft* (Gräsel, 2008) indicate. Gender related aspects in out of school learning are mostly neglected, even though at school the differences between the boys' and girls' cognitive achievement are evident (e.g. PISA, 2006; OECD, 2009). Particularly, in informal science settings such as museums, aquaria, nature centres and zoos a domain specific and gender sensitive treatment of pupils might be especially beneficial. Evidence suggests that in biology (Baram-Tsabari, Sethi, Bry, & Yarden, 2008), e.g. in pupils' interest about plant and animal species (Krombass, Urhahne, & Harms, 2003), boys and girls differ significantly. Therefore a zoological garden might be a rather gender sensitive out of school location. The study presented here is an investigation in the extracurricular environment of a school excursion to a zoological garden (Smith, McLaughlin, & Tunnicliffe, 1998). We are aware that not every aspect of museum learning is considered. In particular, a qualitative perspective with focus on the visit itself by evaluating the process of learning of every child individually (e. g. by videography) might offer further valuable information (Bitgood, 1989; Griffin, Kelly, Savage, & Hatherly, 2005). Still, the aim of our current study was to provide first quantitative empirical proof of ex ante assumed differences between boys and girls in museum learning in a zoological garden.

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How Significant are the Differences between Boys and Girls?

In her *Gender Similarities Hypothesis* Hyde (2005) argues that there are far less psychological differences that are gender specific than apparently assumed. The hypothesis is grounded on a detailed meta-analysis, which shows how minor the influence of gender differences is on most psychological traits. The majority of investigated categories show no or very small differences: for instance the effect sizes in *mathematics concepts* and *mathematics problem solving* (d = 0.03 - 0.16), *vocabulary* (d = 0.02 - 0.06) and *verbal* and *abstract reasoning* (d = 0.02 - 0.04; Hyde, 2005). Actually, only very few distinct gender specific differences can be detected (Hyde, 2005). Hyde's (2005) meta analyses have shown that in tests dealing with visual thinking, for example, boys or men often have more advanced abilities (e.g. *mental rotation*: d = 0.56 and d = 0.73 respectively; Hyde, 2005). Girls or women have shown better results in the Differential Aptitude Test (DAT; *spelling*: d = 0.45, *language*: d = 0.40, Hyde, 2005; Smith, McLaughlin, & Tunnicliffe, 1998).

In the *educational context*, PISA 2003 detected virtually no gender specific differences in the fields of "mathematics" (d = 0.09), "natural sciences" (d = 0.05) and "problem solving" (d = 0.06) (Zimmer, Burba, & Rost, 2004, p. 213). In FIMS, SIMS (First and Second International Mathematics Study) and TIMSS (Third International Mathematics and Science Study) some minor differences were found, in a few mathematics abilities in favour of boys (Hanna, 2000; Kaiser, & Steisel, 2000). Despite these results, that mostly concern cognitive achievements, there are school subjects that are apparently related to gender. Physics, for instance, is regarded as a *boys' subject* (Kessels, 2004; Friedler, & Tamir, 1990; Gardner, 1998): Boys are more interested in physics; and their choice of courses and further career choices are often affected by this disposition (Baram-Tsabari et al., 2008; Jenkins, 2006; Kessels, 2004). According to Pintrich and Schunk (2002) and Schiefele (1998) the quality of learning corresponds with pupils' interest. For girls a higher level of language competence was detected through PISA 2000 and 2003 as one transnational, gender specific differentiation (Stanat, & Kunter, 2003; Zimmer et al., 2004). Interestingly, in Germany biology is widely regarded as a *girls' subject* (BMBF, 2008, p. 29; Gardner, 1998; Friedler, & Tamir, 1990). Statistics as well as decisions on the subject selection of main subjects in high school (Abitur Leistungskurse) can prove these evaluations (BMBF, 2006, p. 128). Baram-Tsabari et al.'s (2008) international survey confirms these findings: Overall, across borders and cultures, girls are more interested in biology than boys. More specifically, for girls in Germany Gehlhaar, Klepel and Fankhänel (1999) were able to prove a higher interest in zoology and botany (Todt, 2000; Krombass, Urhahne, & Harms, 2003).

Reasons for specific differences in the performances of boys and girls in school can be proven to be related to stereotypical labelling (Steele, 1997; Fear-Fenn, & Kapostasy, 1992; Gardner, 1998). Spencer, Steele and Quinn (1999) were able to show that a person tends to react according to the expected stereotypical behaviour (Dar-Nimrod, & Heine, 2006). Especially stereotypes regarding the social category of gender can increase the severity of these differentiations (Prentice, & Miller, 2006). In coeducational classes, girls showed signs of gender awareness more often than they did in mono-educational classes (Kessels, 2004). The *boys' subject* physics is usually taught in coeducational classes. Gender awareness presumably affects the girls' performance negatively (Kessels, 2004).

Another explanation for the different learning behaviour might be a special quality of human cognition, or more precisely, the ability of predicative and functional thinking: predicative thinkers are characterised by a special cognitive responsiveness for similarities and they are able to relate specific elements according to their systematic and structured connection. Functional thinkers, on the other hand, have a special cognitive responsiveness for differences and are able to deduce modes of action very well (Mölle, Schwank, Marshall, Klöhn, & Born, 2000; Schwank, 2003). The majority of girls tend to think predicatively; boys on the other hand tend to think functionally (Bischof-Köhler, 2004, p. 257; Schwank, 2003; Kimura, 1999).

Specifics of Extracurricular Learning

Extracurricular learning is complex and very strongly defined by the subjectivity of the learner; especially during school excursions (Griffin, 1998). In their C*ontextual Model of Learning* (CMoL), Falk and Dierking (1992, 2000; Harms, & Krombass, 2008; Wilde, 2007) attempt to describe and explain the particularities of learning in museums, science centres or zoos. This framework should work equally well for compulsory and free-choice museum learning (Falk, & Dierking, 2000, p. 136). In CMoL (Falk, & Dierking, 2000) three contexts are characterised: the *personal*, the *sociocultural* and the *physical* context. The *personal context* includes motivations and expectations of the learner, their prior knowledge, their interests and beliefs and whether the visit was intrinsically- or extrinsically motivated. The *sociocultural context* describes the influence of within-group sociocultural mediation and the facilitated mediation by others. The *physical context* consists of orientation and an advance organizer for guidance in the learning environment, the importance of real objects and appropriate contexts as well as experiences outside of the learning environment. Every single one of these factors influences extracurricular learning, although the following factors should be ranked with regards to their special relevance for this study.

In the framework of the *personal context* motivation (Griffin, Kelly, Savage, & Hatherly, 2005; Hein, 1998) and interest play a significant role. Especially, the relevance of intrinsic motivation is undisputed in its importance for learning (Deci, & Ryan, 1985; Ryan, & Deci, 2000). Extracurricular learning contexts offer opportunity for self-regulated work (Dierking, Falk, Rennie, Anderson, & Ellenbogen, 2003). They give learners the option to experience themselves as autonomous and competent persons. Intrinsic motivation relies especially on the satisfaction of the psychological needs of autonomy and competence (Ryan, & Deci, 2000). Therefore, intrinsic motivation can be developed in the extracurricular learning environment. An important form of intrinsic motivation is “the holistic sensation that people feel when they act with total involvement” (Csikszentmihalyi, 1975, p. 36: Csikszentmihalyi (1975) calls it the *flow*. In particular in an extracurricular setting this “motivational absorption” could be a good criterion to describe important aspects of pupils in their *process* of learning. Intrinsic motivation in relation to the object is described with the term *interest*. The individual interest (disposition) describes a stable preference for a specific learning tool. A situational interest (interestingness), on the other hand, refers to the condition and motivation that is related to a specific situation (Krapp, 1992, 1993; Mitchell, 1993; Renninger, Hoffmann, & Krapp, 1998; Todt, & Schreiber, 1996). According to Gehlhaar et al**.** (1999) girls show stronger individual interest in animals than boys. This disposition might have effects on girls’ learning motivation and their learning achievement in the zoological garden (Schiefele, 1998).

The *sociocultural context* with its influences through within-group sociocultural mediation and the facilitated mediation by others is especially relevant for the particular task the pupils worked on at that particular time. A possible gender typing of the subject (*girls’ subject* biology) probably plays a role for the gender specific differences in the performance, but presumably the composition of the study group, the sex of the guide in the zoological garden, and the sex of the accompanying teacher do as well (Kessels, 2004).

In the scope of the *physical context*, the 'design' of the zoological garden, the selection of the exhibits, and their presentation could play a role for the different possible gender-specific learning processes (Falk, & Storksdiek, 2005a, 2005b). The zoological garden chosen in this study tries to counteract the alienation of the pupils to the regional fauna. The focus is on cognitive and affective concerns of education.

During a visit to a zoological garden, the *physical context is connected* with the *personal* and *sociocultural context* by offeri\ng learning situations that urge the individual pupils or a member of the group to engage with their peers and the educational content of the zoological garden. All factors of the *Contextual Model of Learning* are relevant for the extracurricular learning process. Especially cognitive and motivational levels are brought into focus in the study presented here. In accordance with the latest state of research the following question arises: Do boys and girls learn differently in the extracurricular environment of the zoological garden?

Hypotheses

According to Hyde (2005), in most categories the genders hardly differ on the cognitive level. Merely few tests, e.g. in language competence and abstract thinking, result in noteworthy gender differences. In this study, language aspects as well as three-dimensional thinking are part of the task, e.g. questions regarding the size and shape of the enclosures. However, the cognitive challenges regarding the gender differences are chosen equally. The *first hypothesis* reads as follows: The knowledge gain for girls and boys is equally good. For statements on the motivational level, the *personal context* of the *Conceptual Model of Learning* is important. Girls show a higher interest in animals. This results, most likely, in a higher intrinsic motivation during the visit in the zoological garden. The *second hypothesis* reads as follows: Girls experience the visit to the zoological garden to a higher degree intrinsically motivated than boys. This applies to the process related motivation, the *flow-experienc*e (Csikszentmihalyi, 1975; FKS: Rheinberg, 2004) and also to the retrospectively measured intrinsic motivation, according to the Intrinsic Motivation Inventory (IMI; Deci, & Ryan, 2005).

Methods

Sample

This is a quasi-experimental study (Shadish, Cook, & Campbell, 2002). The sample consists of ten fifth grade classes (N = 223) from four german schools of the highest stratification level (Gymnasium). The average age of the pupils was 10.45 years. The experimental group consisted of 110 girls and 87 boys. The control group merely consisted of one class (12 girls, 14 boys).

Test Instruments

The instruments to measure knowledge gain were specially developed for this study. Test 1 consisted of seven open items in the form of short essay questions *(*Allen, & Yen, 1979; Bortz, & Döring, 2002). In test 1 the pupils could reach a maximum of two points per item: 0 = wrong, 1 = almost correct and 2 = correct. Test 2 consisted of 38 closed-ended items of a multiple choice type (Bortz, & Döring, 2002). In this test the pupils could reach merely one point per item: 0 = wrong, 1 = correct. Both tests are listed in the appendix. Table 1 shows the reliability factor (Cronbach's Alpha) of both knowledge tests (Allen, & Yen, 1979: Bortz, & Döring, 2002).

Eleven items from the *Intrinsic Motivation Inventory* (IMI; Deci, & Ryan, 2005) were used to measure the intrinsic motivation with a five-ary Likert-scale from 0 ("not at all true") to 4 ("very true") in the post-test. The four subscales are: *interest/enjoyment*, *perceived competence*,

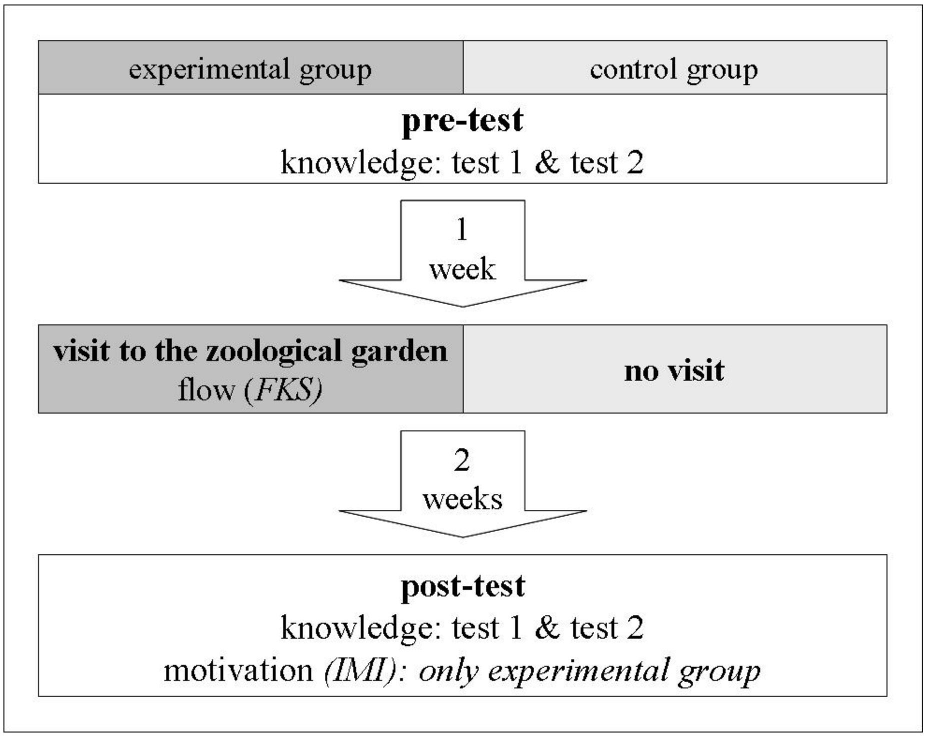

Figure 1. Design of the study

perceived choice and *relatedness*. The items of the last sub-scale represent the relationship between pupils and guide. During the intervention, a five-ary Likert-scale with eight items of the 'Flow-Kurzskala' (FKS; a short scale of flow-measurement) according to Rheinberg (2004) was used to measure the *flow experienc*e during the working process at two work stations. The reliability factors (Cronbach's Alpha) for IMI and *FKS* are listed in Table 2.

Design of the Study

The study was conducted with a pre-test, an intervention and a post-test. One week prior to the visit at the zoological garden the pre-test was conducted, the post-test two weeks later. The control group only completed the pre- and post-test without the extracurricular intervention (see Figure 1).

Zoo Visit

The pupils visited the zoological garden with their classes accompanied by teachers. All groups were of both sexes. In the zoological garden the pupils of one class were randomly divided into three groups, which were of both sexes and of equal numbers. Each of these groups was accompanied by a guide. The guides then arranged the pupils randomly into sub-groups of three or four, i.e. most pupils worked in sub-groups of both sexes. Three workstations were passed in the park. They were called "adaptation" of white storks (*Ciconia ciconia*) and eagle owls (*Bubo bubo)*, "social behaviour" of house mice (*Mus musculus)* and tarpans *(Equus ferus)*, and "species-appropriate enclosures" of northern racoons (*Procyon lotor*) and wild boars (*Sus scrofa*). At each of these stations the pupils worked in groups of three or four (Lou, Abrami, Spence, Poulsen, Chambers, & d`Apollonia, 1996) on their worksheets for approx. 30 minutes (Randler, Baumgärtner, Eisele, & Kienzle, 2007; Griffin, 1994). The appointed guide of each group did not intervene to assure independent and self-regulated work of the pupils.

Table 1. Knowledge test 1 (open Items) and test 2 (closed-ended Items), reliability factor (Cronbach's Alpha)

Measuring Instruments	**Number of Items**	**Cronbach's Alpha**
test 1	7	.64
test 2	38	.80

Table 2. Scales of motivation (IMI, FKS), reliability factor (Cronbach's Alpha)

Scales		**Number of Items**	**Cronbach's Alpha**
IMI	interest/enjoyment	3	.82
	perceived competence	3	.77
	perceived choice	2	.73
	relatedness	3	.86
Flow	station 1	8	.83
	station 2	8	.80

Results

First of all, the knowledge gain of the whole group is important. As expected the results of both tests improved from pre- to post-test for all pupils of the experimental group: test 1 (open items): $F(1;195) = 40.32$; $p < .001$, $d = 0.91$; test 2 (closed items): $F(1;195) = 21.75$; $p < .001$, $d = 0.67$. The control group (pre-test, no visit to the zoo and post-test), on the other hand, had no knowledge gain (test 1 (open items): $F(1;25) = 0.55$; p = ns; test 2: (closed items): $F(1;25) = 0.79$; p = ns). A pre-test effect can be excluded.

As stated before, in the focus of the study are the gender specific learning effects. Still, the picture is not clear: In test 1, the girls profited from the extracurricular environment to a highly significant degree from pre- to post-test, more than the boys ($F(1;195) = 9.68$; $p < .01$; $d = 0.44$).

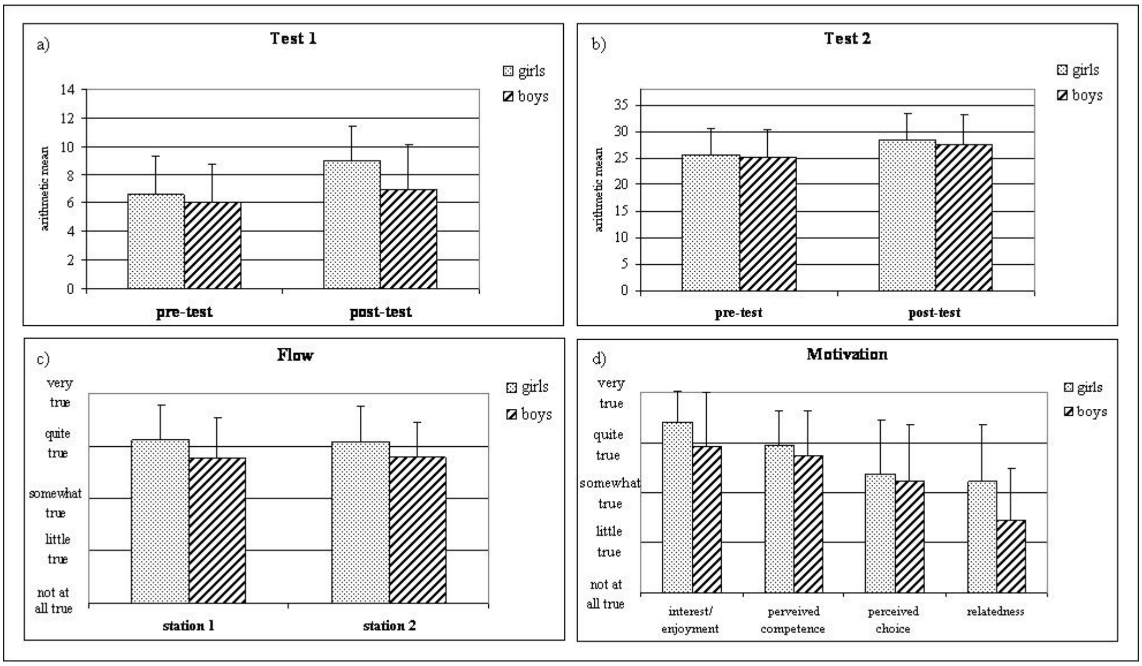

Figure 2: a) knowledge of girls (N = 110) and boys (N = 87) in test 1 (14 points max.) and b) test 2 (38 points max.), c) measurements of the flow-experience (FKS) of girls (N = 99) and boys (N = 80); y-axis: five-ary Likert-scale, d) intrinsic motivation of girls (N =110) and boys (N = 87); y-axis: five-ary Likert-scale

In test 2, on the other hand, no clear statistical differences can be detected ($F(1;195) = 2.35$; p = n.s.; $d = 0.22$; figure 2 a and b).

In extracurricular settings motivational parameters are regarded to be especially important: In this context the test instruments *IMI (Intrinsic Motivation Inventory*) and *FKS* (*Flow- Kurzskala*) are used to show two specific levels of intrinsic motivation. Both FKS measurements (Rheinberg, 2004) support the assumption that girls are more motivated (Figure 2 c). In both cases the girls experienced significantly higher flow than the boys (station 1: $F(1;177) = 11.58$; $p < .01$, $d = 0.51$; station 2: $F(1;177) = 8.74$; $p < .01$, $d = 0.44$).

Figure 2 d confirms these findings. It shows a definite pattern: The figures of all sub-scales of IMI (*interest/enjoyment*, *perceived competence*, *perceived choice* and *relatedness*) are higher for the girls. Statistically provable are the differences in *interest/enjoyment*, ($F(1;171) = 12.42$; $p < .01$, $d = 0.54$), in *perceived competence* ($F(1;171) = 4.39$; $p < .05$; $d = 0.32$) and in *relatedness* ($F(1;171) = 17.27$; $p < .001$; $d = 0.64$).

Discussion

All pupils showed significant knowledge gain. The experiences of the pupils in the extracurricular environment can cause a lasting influence on their knowledge (Rennie, & Johnston, 2004). The effect size is comparable to similar studies (Krombass, & Harms, 2006; Wilde, & Bätz, 2006; Wilde, & Urhahne, 2008). The central question of this study is concerned with gender related learning behaviour in particular on cognitive and motivational levels. The girls' results are better in many aspects: However, in test 2, statistically, there is no difference between boys and girls to prove. The girls showed significant better outcomes with open tasks, the more challenging cognitive test (test 1) (Anderson, & Krathwohl, 2001). Overall, the first hypothesis cannot be sustained. Boys and girls do not learn equally well. Moreover, both motivation tests (IMI, FKS) showed a higher intrinsic motivation of the girls. The immediate experience of intrinsic motivation differed: Girls experienced more flow. Furthermore, they enjoyed the visit more and perceived themselves as more competent. Very clearly, the perceived relation to the guides differed: Girls experienced more affiliation.

The question that arises is how these results could be explained. First, the *Contextual Model of Learning* (Falk, & Dierking, 2000; Wilde, 2007) characterises the visitor's interest as an important factor of the *personal context*. It stands to reason that this could be related to the girls' higher interest in biology and especially in animals (Gehlhaar et al., 1999), which is a particularly important factor for a visit to a zoological garden. The girls' higher interest could have led to a higher intrinsic motivation during the course of the visit (Deci, & Ryan, 1993; Schiefele, 1992). Both levels of intrinsic motivation, that is to say, the immediate experience (FKS; Rheinberg, 2004) and the retrospectively measured intrinsic motivation (IMI; Deci, & Ryan, 2005; Krombass, & Harms, 2006) presumably benefit from higher interest. This corresponds to the higher knowledge gain. Gottfried (1985, 1990) was able to prove a connection between success in school and intrinsic motivation. The higher intrinsic motivation of girls might have resulted in a better learning quality.

Secondly, the *sociocultural context* in the *Contextual Model of Learning* (Falk, & Dierking, 2000; Wilde, 2007) has the role of a social mediator and is defined as crucial for the extracurricular learning process. The *sociocultural context* stresses the importance of mediators within and outside the study group. Biology is regarded as a *girls' subject* (BMBF, 2008, p. 29). Based on possible gender attribution in the subject of biology (stereotype threat; Dar-Nimrod, & Heine, 2006; Spencer et al., 1999), Kessels' (2004) findings could be relevant for the outcome at hand. In the *boys' subject* physics, girls had poorer results in coeducational study groups than in mono-educational study groups. Kessels (2004) was able to find an empirical proof for the girls' own gender awareness and the resulting tendency to act accordingly. In the study at hand, the same could have been the case for boys in the *girls' subject* biology. This would explain their poorer cognitive results.

Thirdly, the zoological garden visited by the pupils does not have a spectacular presentation of endangered or dangerous animals but concentrates on presenting the local fauna in species-appropriate enclosures. This *physical context* was addressed in the work sheets with the intention to appeal to every person individually (*personal context*), and also to offer learning opportunities to the groups (*sociocultural context*). The nature of the tasks could also have included a component concerning the differences of the sexes. A vital attempt to explain the learning difference could be the school of thought according to which girls tend to think predicative (Bischof-Köhler, 2004). Girls try to see the whole picture (Schwank, 2003), whereas boys tend to think on a functional level (Bischof-Köhler, 2004), which means boys concentrate on the interdependency of elements (Schwank, 2003). The main tasks during the visit to the zoo were to describe the cages of the animals, observe their behaviour and also to observe morphological structures. These tasks presumably correspond to the predicative way of thinking. Therefore, it leads to conclude that girls had fewer difficulties with these tasks. It is likely that for girls the ratio between their own capability and the demands of the tasks was on their level. This is seen as an important requirement for the *flow* (Csikszentmihalyi, 1975). This also explains the girls' higher flow-value. They were probably also feeling very competent when they excelled in their tasks. Their values on the corresponding IMI sub-scale were higher than the ones of the boys. The girls' higher verbal abilities (Stanat, & Kunter, 2003; Zimmer et al., 2004) back up this attempt at an explanation even further. To realise and describe (predicative thinking) every aspect of a specific qualification tasks on language practice are especially useful. Possibly, not all of the three explanations are beneficial (higher interest of the girls, gender-congruency or in-congruency in the *girls' subject* biology, tasks concerning language practice including predicative thinking), but neither can any interpretation be excluded at this point.

Educational Implications

The findings of the study can be seen in relation to the better grades of girls in school. The performance in school corresponds to the findings of intrinsic motivation. Apparently, the classes in the zoological garden appealed more to the girls than to the boys. Consequently, a concept of a mono-educational study group (Kessels, 2004) with male instructors (Beuster, 2006, p. 93), *boys' topics* (Gehlhaar et al., 1999), stronger management (Beuster, 2006, p. 93) and elements of competition (Boldt, & Schütte, 2006) could support boys instead.

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Müfredatın dışındaki öğrenme ortamlarında kız ve erkek ogrenciler arasındaki farklar

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Cinsiyetler arasındaki sadece birkaç psikolojik farklılık deneysel kanıtlanabilir. Burada sunulan çalışma hayvanat bahçesine bir okul gezisi esnasındaki müfredat dışındaki bir öğrenme ortamındaki kız ve erkekler arasındaki farklarla ilgilidir. Esas odak noktası sözü edilen öğrenme ortamının bilişsel ve motivasyonal düzeyleridir. Yüksek lise (Gymnasium) düzeyindeki 223 beşinci sınıf öğrencisine bir ön test-son test çalışma deseni uygulanmıştır. Kız öğrenclier daha yüksek düzeyde bir içsel motivasyon göstermişler ve açık uçlu bilgi sorularında istatistiksel olarak anlamlı daha yüksek bir kazanım elde etmişlerdir. Sonuçlar öğrenmenin bağlamsal modeli çerçevesinde tartışılmıştır.

Anahtar kelimeler: Öğrenmenin bağlamsal modeli, müfredat dışı öğrenme, cinsiyet