Universität Bayreuth
Lehrstuhl Didaktik der Biologie

Kognitive Leistungen, Einstellungen und Assoziationen:

Eine erlebnisorientierte Interventionsstudie am außerschulischen Lernort Nationalpark

Dissertation

zur Erlangung des akademischen Grades

- Dr. rer. nat. –

der Fakultät für Biologie, Chemie und Geowissenschaften
der Universität Bayreuth

vorgelegt von
M. Sc. Biol.

Olivia Dieser
2015

Die vorliegende Arbeit wurde in der Zeit von Dezember 2011 bis Februar 2015 in Bayreuth am Lehrstuhl für Didaktik der Biologie unter Betreuung von Herrn Professor Dr. Franz X. Bogner angefertigt.

Vollständiger Abdruck der von der Fakultät für Biologie, Chemie und Geowissenschaften der Universität Bayreuth genehmigten Dissertation zur Erlangung des akademischen Grades eines Doktors der Naturwissenschaften (Dr. rer. Nat.).

Dissertation eingereicht am: 12.02.2015

Zulassung durch die Promotionskommission: 25.02.2015

Wissenschaftliche Kolloquium: 17.04.2015

Amtierender Dekan: Prof. Dr. Rhett Kempe

Prüfungsausschuss:

Prof. Dr. Franz Xaver Bogner	(Erstgutachter)
Prof. Dr. Ludwig Haag	(Zweitgutachter)
Prof. Dr. Stefan Schuster	(Vorsitz)
Prof. Dr. Gerrit Begemann	

INHALTSVERZEICHNIS

1 Summary

Due to the increasing urbanisation and the strong media orientation of our today's society, adolescents rarely use the possibilities to spend time outside in nature and to experience natural environments. Consequences are multiple, ranging from the lack of exercise and health problems to large gaps of knowledge about the local fauna and flora (e.g. Miller 2005; Janssen et al. 2005; Faber Taylor and Kuo 2009). Therefore, adolescents need increasingly information about changes affecting their environments such as climate change, overpopulation or overexploitation of natural resources. Adolescents are the future stakeholders, who have to deal responsibly with nature. Consequently, basic knowledge about natural processes, ecosystems, as well as about the local fauna and flora are essential.

For the present study an outdoor education programme in a National park was monitored, based on previous studies analysing the influence of direct experiences in nature on students' cognitive achievement and environmental perception (Bogner 1998b; Duerden and Witt 2010). The intention of this programme was, to (re)introduce young students with direct and hands-on approaches to their natural environment. In order to evaluate this objective, the influence of the educational programme on students' knowledge increase and state emotions (study A), as well as on their environmental perception was monitored (study B). Furthermore, first results about students' associations regarding wolf and lynx were investigated (study C).

Within study A the influence of direct experiences in nature and hands-on approaches could be confirmed to be increasing students' knowledge in the long-term. Additionally, emotional follow-up activities influenced the cognitive achievement of the students significantly even on a long-term basis. Furthermore, the environmental programme fostered students' positive state emotions, which lead to an additional increase of knowledge. In contrast, a positive change of the students' environmental perceptions through the programme could not be achieved (study B). Young students seem to need direct lessons on environmental issues like preservation and utilisation. The transfer of mere basic knowledge seems not to be enough for young students to influence their environmental perception in a next step. However, students with higher pro-environmental perception showed higher potential for learning success. The analysis of the associations in study C showed students being capable to describe a wide range of species' natural history domains. Furthermore, the existing knowledge gap was filled through the environmental programme. However, students still seem to be influenced by the negative image of the "dangerous" carnivores. Therefore, respective education programmes are

needed to sensitise the students regarding endangered species, especially those which are re-establishing in Germany.

In conclusion, a hands-on structured education programme comprising direct experiences in nature fosters cognitive and emotional achievement levels leading to a significant learning success. However, to positively change environmental perceptions, lessons with specific conservation foci are needed. This needs consideration for future educational instructions, since pro-environmental perceptions showed to increase the cognitive achievement (Bogner 1999; Fremerey and Bogner 2015). Using the word association method, wide-ranging insights of the students' associations towards wolf and lynx are visible. The still negative image of these species, however, is shown as improvable through the short, effective and emotional part of the programme.
Considering today's development of our society in the light of this present study, schools should use such hands-on orientated education programmes in local nature more often, especially for lower classes. Students need to get in closer contact with their natural environment, but need to be informed additionally about important basics as well as becoming prepared for future changes of their environment.

2 Zusammenfassung

Auf Grund der zunehmenden Urbanisierung und starken Medienorientierung nutzen Kinder und Jugendliche in der heutigen Gesellschaft nur noch selten die Möglichkeiten, sich in der Natur aufzuhalten und sich mit ihrer natürlichen Umgebung auseinander zu setzten. Die daraus resultierenden Folgen sind Bewegungsmangel, gesundheitliche Probleme, Konzentrationsschwierigkeiten und große Wissenslücken zur einheimischen Tier- und Pflanzenwelt (z. B. Miller 2005; Janssen et al. 2005; Faber Taylor und Kuo 2009). Darum ist es gerade in der heutigen Zeit wichtig, dass Kinder und Jugendliche auf Veränderungen in ihrer Umwelt, wie Klimawandel oder Übernutzung der natürlichen Ressourcen, aufmerksam gemacht werden. Sie sind die zukünftige Generation, die als Interessensvertreter verantwortungsbewusst mit der Natur umgehen muss. Grundlegendes Wissen über die natürlichen Vorgänge, Ökosysteme und auch die einheimische Tier- und Pflanzenwelt sind dafür essentiell.

Aufbauend auf vorherige Studien mit erfolgreicher Wissensvermittlung und Förderung umweltfreundlicher Einstellungen durch direkte Erfahrungen in der Natur (Bogner 1998b; Duerden und Witt 2010), wurden die Auswirkungen eines Unterrichtsprogramms am außerschulischen Lernort Nationalpark untersucht. Ziel dieses Programmes war es, junge Schüler[1] mit naturnahen und möglichst erlebnisorientierten Methoden wieder an ihre natürliche Umwelt heranzuführen. Der wissenschaftliche Teil dieser Studie verfolgte dabei den Einfluss eines solchen Programmes auf den Wissenszuwachs und die Lernemotionen (Teilarbeit A), wie auch auf die Umwelteinstellungen der Schüler (Teilarbeit B). Darüber hinaus sollten erste Erkenntnisse zu Assoziationen von Schülern gegenüber den Raubtierarten Wolf und Luchs ermittelt werden (Teilarbeit C).

In Teilarbeit A konnte bestätigt werden, dass erlebnisorientierte Erfahrungen mit der Natur das Wissen der Schüler langfristig steigern können. Zusätzlich beeinflusste eine emotionsgeprägte Nachbereitung den Wissenserfolg der Schüler signifikant und nachhaltig. Auch während der Intervention konnten die positiven Lernemotionen angesprochen werden, die sich wiederum steigernd auf den Wissenserwerb auswirkten. Eine Veränderung hin zu umweltfreundlicheren Einstellungen konnte entgegen den Erwartungen durch die Intervention nicht erreicht werden (Teilarbeit B). Die Vermittlung reinen Faktenwissens reicht bei jungen Schülern demnach nicht aus, um ein Umdenken in Richtung umweltfreundlicheren Einstellungen zu erzielen. Junge Schüler benötigen daher eine direkte Vermittlung von Umweltthemen zu Naturschutz und Naturnutzung. Dennoch

[1] Im Folgenden wird der Ausdruck „Schüler“ für beide Geschlechter verwendet

zeigten Schüler mit umweltfreundlicheren Einstellungen einen besseren kognitiven Lernerfolg. Die Analyse der Assoziationen in Teilstudie C zeigte zudem, dass Schüler über ein sehr weites Spektrum die Lebensbereiche des Wolfes und Luchses beschreiben und bestehende Wissenslücken zu den Tierarten schließen können. Dennoch scheinen die Schüler immer noch von dem negativen Bild der „gefährlichen“ Raubtiere geprägt zu sein. Entsprechende Sensibilisierungen gegenüber gefährdeten Tierarten, vor allem solchen, die sich in Deutschland wieder verbreiten, sind daher unbedingt notwendig.

Zusammenfassend lässt sich sagen, dass ein erlebnisorientiertes Unterrichtsprogramm mit direkten Erfahrungen in der Natur sowohl kognitive Leistungen der Schüler fördert als auch emotionale Bereiche der Schüler anspricht und dadurch den Lernerfolg signifikant beeinflusst. Zur positiven Veränderung der Umwelteinstellung von jungen Schülern bedarf es aber einer gezielten Anwendung von Unterrichtseinheiten zu Umweltschutzthemen. Zukünftige Bildungsangebote sollten diese Themen miteinplanen, denn umweltfreundliche Einstellungen können zusätzlich den Lernerfolg der Schüler steigern (vgl. Bogner 1999; Fremerey und Bogner 2015). Mit der Methode der Wort-Assoziationen gelang ein weitreichender Einblick in die Sichtweisen von Schülern über die Tiere Wolf und Luchs. Das immer noch bei den Schülern verbreitete, negative Bild dieser Tiere konnte durch die kurze, effektive und emotional geprägte Interventionseinheit langfristig verbessert werden. Angesichts der heutigen Entwicklung unserer Gesellschaft und der Ergebnisse dieser Studie sollten Schulen, besonders in den unteren Jahrgangsstufen, erlebnisorientierte Bildungsprogramme in der heimischen Natur häufiger nutzen. Dadurch können sie den Schülern ihre natürliche Umwelt näher bringen, sie über wichtige Grundlagen informieren und auch auf die zukommenden Veränderungen der Umwelt aufmerksam machen.

3 Ausführliche Zusammenfassung

3.1 Einleitung

In Anschluss an die 1992 von den Vereinten Nationen veröffentlichte Agenda 21, wurde 2002 eine UN-Dekade für 2005 bis 2014 formuliert (Unesco 2005), um Bildung für nachhaltige Entwicklung weltweit in den Bildungssystemen zu verankern (United Nations 1992). Bildungsangebote wurden daraufhin, sowohl in Schulen als auch in öffentlichen Einrichtungen ausgebaut. Zoos, Museen oder Nationalparks und auch Schullandheime oder Freizeit-Camps entwickelten Programme mit Umweltthemen bezüglich ihres spezifischen Bereichs. Projekte wie „Schulgarten“ wurden von Schulen vermehrt umgesetzt und Unterrichtseinheiten in Kooperation mit außerschulischen Institutionen wie z. B. „Das grüne Klassenzimmer“ intensiver genutzt (Drissner et al. 2010; Fančovičová und Prokop 2011). Der außerschulische Lernort wurde zur Steigerung der Naturverbundenheit von Schülern und zur Beeinflussung des langfristigen Lernens durch eigenständiges Entdecken, Beobachten und Interpretieren der Natur und ihrer Umgebung genutzt (Hammerman 1980). Zusätzlich sollten die in den Bildungsstandards verankerten Schlüsselkompetenzen wie Kommunikationsfähigkeit, Koordination und Zusammenarbeit gestärkt werden (KMK 2005). Zeitgleich wurden deshalb größere Studien zur tatsächlichen Effektivität dieser Programme bezüglich Wissenserwerb und Änderung von Umwelteinstellungen und -verhalten durchgeführt (z. B. Leeming et al. 1993; Bogner 1998a; Dillon et al. 2006). Faktoren wie Vorwissen, Vor-Erfahrungen und Alter der Schüler, wie auch die Länge, die Örtlichkeit und die Art der Programmdurchführung spielen eine entscheidende Rolle (Dillon et al. 2006). Darüber hinaus wurde besonders in den letzten Jahren bekannt, dass der Verlust des Bezugs zur Natur gerade bei Jugendlichen nachhaltige Folgen, wie z. B. Gesundheitsschäden oder fehlende soziale Kompetenzen mit sich zieht (Faber Taylor et al. 2002; Janssen et al. 2005; Faber Taylor und Kuo 2009).

3.2 Theoretischer Hintergrund

Umweltbildung am außerschulischen Lernort Nationalpark

Umweltwissen, positive Umwelteinstellungen und ein hohes Bewusstsein für den Umweltschutz sind die Ziele der Umweltbildung und essentieller Bestandteil der Bildung für nachhaltige Entwicklung. Diese Ziele können aber nicht erreicht werden, wenn zum

einen das allgemeine Interesse und der Bezug zur Natur bei Schülern sinkt und zum anderen wesentliche Grundkenntnisse über die einheimische Tier- und Pflanzenwelt fehlen (Lindemann-Matthies 2002; Lindemann-Matthies 2005). Für die vorliegende Studie wurde deshalb bewusst der Nationalpark Bayerischer Wald als Interventionsort zur Vermittlung der Ziele in der Umweltbildung und gleichzeitig als Motivator für die derzeit fehlenden Interaktionen in und mit der heimischen Natur gewählt. Er bietet die Möglichkeit einen einheimischen Wald in seiner ursprünglichen Form mit seiner Tier- und Pflanzenwelt kennenzulernen. Ausgebildete Waldführer unterstützen Schülergruppen und ermöglichen dadurch eine gezielte Förderung der Kommunikation und Zusammenarbeit, können aber auch auf die individuellen Fragen der Schüler eingehen. Der Nationalpark trägt zudem mit verschiedenen Ausstellungen, Interaktionsfeldern und besonderen Ökosystemen zur effizienten Festigung der Unterrichtseinheiten bei. Darüber hinaus bietet ein großes Tierfreigelände die Möglichkeit wilde, einheimische Tiere zu beobachten und wissenschaftliche, wie auch sozial-kontrovers diskutierte Zusammenhänge gefährdeter Tierarten, wie beispielsweise Wolf und Luchs, kennenzulernen und besser zu verstehen.

Wissen und Umwelteinstellungen

Bisherige Studien konnten bereits wesentliche Faktoren herausfiltern, die zur Steigerung des Umweltwissens, wie auch zur Veränderung von Umwelteinstellungen, beitragen (z. B. Falk und Balling 1982; Bogner 1998b; Duerden und Witt 2010). Dabei stellte sich heraus, dass Umweltwissen von Schülern am einfachsten zu beeinflussen ist. Umweltwissen trägt aber auch dazu bei, Einstellungen und möglicherweise auch das Verhalten von Schülern positiv zu verändern (Kollmuss und Agyeman 2002). Umweltwissen lässt sich sowohl durch den klassischen Frontalunterricht mit indirekten Beispielen aus der Natur, als auch durch direkte Erfahrungen in der Natur vermitteln (Leeming et al. 1993). Auch die Länge der Unterrichtseinheit wirkt sich nicht negativ auf die Erhöhung des Umweltwissens aus (Bogner 1998b; Duerden und Witt 2010). Bessere Ergebnisse werden jedoch durch eine ausreichende Vorbereitung der Schüler auf den außerschulischen Unterricht erzielt (Duerden und Witt 2010). Auswirkungen einer Nachbereitung des Unterrichtsstoffes auf das individuelle Umweltwissen wurden dagegen noch nicht untersucht. Umwelteinstellungen sind, wie bereits erwähnt, abhängig von mehreren verschiedenen Faktoren. Sie sind relativ stabil und lassen sich deshalb schwer verändern. Besonders die Dauer und auch die Art der Unterrichtseinheit stellten sich als entscheidende Einflussfaktoren heraus. Je länger ein Bildungsprogramm dauert, desto stärker verändern sich die Umwelteinstellungen der Schüler positiv (Bogner 1998b; Duerden und Witt 2010). Schüler, die an Unterrichtsprogrammen mit direkten Erfahrungen zu Natur, Tier- oder Pflanzenwelt teilnehmen, erreichen zudem ein höheres Bewusstsein für Umweltschutz

(Dettmann-Easler und Pease 1999; Bogner 1999; Bogner und Wiseman 2004). Zur Messung der Umwelteinstellungen wurde in der vorliegenden Studie die von Bogner und Wiseman entwickelte 2-MEV- (2 Major Environmental Values) Skala verwendet (Bogner und Wiseman 1999, 2002, 2006). Mit Hilfe dieser Skala können zum einen die Einstellungen eines Schülers gegenüber der *Natur(aus)nutzung* (Utilization) und zum anderen gegenüber des *Naturschutzes* (Preservation) ermittelt werden. Die Skala wurde bereits mehrmals unabhängig überprüft und bestätigt (Munoz et al. 2009; Boeve-de Pauw und van Petegem 2011; Schneller et al. 2013; Liefländer und Bogner 2014). Eine Stabilität der beiden Faktoren „Preservation" und „Utilization" über mehrere Testzeitpunkte wurde bisher noch nicht untersucht. Würde solch eine Stabilität bestehen, könnte die 2-MEV-Skala auch für Untersuchungen der Umwelteinstellungen innerhalb einer Langzeitstudie mit mehreren Untersuchungszeitpunkten genutzt werden.

Lernemotionen

Unterrichtsprogramme, die mit Hilfe hands-on [2] basierter Inhalte umgesetzt wurden, konnten neben den kognitiven, auch die affektiven Bereiche von Schülern ansprechen (Fröhlich et al. 2013). Diese sogenannten Lernemotionen werden generell in andauernde, erfahrungsbasierte („trait emotions") und kurzfristig, situationsbedingte („state emotions") Lernemotionen unterschieden (Pekrun 1992; Randler 2004; Randler et al. 2011). Hier lag der Forschungsschwerpunkt vorwiegend in der Auseinandersetzung mit situationsbedingten negativen Lernemotionen im Unterricht (Pekrun 1992; Gläser-Zikuda et al. 2005; Derakshan und Eysenck 2010). Im Gegensatz zu Lehrer-zentrierten Unterrichtseinheiten konnten bei Interventionen mit direktem Erfahrungsbezug intensivere Emotionen und dadurch ein erhöhter Wissenszuwachs erzielt werden (Allen 2010). Studien zur Erfassung von situationsbedingten Lernemotionen innerhalb außerschulischer, erlebnisorientierter Unterrichtseinheiten und den damit verbundenen Einflussmöglichkeiten auf die kognitiven Fähigkeiten der Schüler wurden bisher noch nicht durchgeführt. Deshalb wurde in der vorliegenden Studie die Kurzskala der situationsbedingten Emotionen angewendet, um mögliche affektive Einflussfaktoren der Intervention auf den Wissenserwerb der Schüler zu ermitteln.

Assoziationen zu Wolf und Luchs

Mit Hilfe von Assoziationen ist es möglich, individuelle Erinnerungen, persönliche Hintergründe und gleichzeitig affektive Reaktionen gegenüber einer bestimmten Sache oder eines Lebewesens zu erhalten (Bogner und Wiseman 1997; Hirsh und Tree 2001). Assoziationen stellen dadurch eine besondere Möglichkeit dar, detaillierte Informationen

[2] Hands-on: erlebnisorientiert, aktiv, spielerisch, sehr offen gestaltet

über die kognitiven und affektiven Verknüpfungen eines Schülers zu einem bestimmten Stimulus zu erfahren. In der vorliegenden Studie wurden Wort-Assoziationen erhoben. Schüler nennen hierbei eine bestimmte Anzahl an Wörtern, die ihm spontan zu einem bestimmten Stimulus Wort (hier Wolf und Luchs) einfallen. Generell wurden in den vergangenen Jahren aber nur wenige Studien über das Wissen, die Einstellung und auch die Bezüge von Schülern zu Tieren im Allgemeinen untersucht. Dennoch wurden in den durchgeführten Studien große Wissenslücken besonders von gefährdeten Tierarten festgestellt, die sich als Folge auch in z.T. negativen Einstellungen gegenüber diesen Tierarten widerspiegelten (Kellert 1985; Bath und Farmer 2000; Bjerke et al. 1998; Hermann und Menzel 2013). In Studien skandinavischer Länder wurden vor allem innerhalb der betroffenen Bevölkerung negative Einstellungen gegenüber Wolf und Luchs gefunden. Da sich Wolf und Luchs als gefährdete und geschützte Raubtiere in Deutschland erneut ansiedeln, war es ein wichtiges Anliegen innerhalb dieser Studie, die Assoziationen von jungen Schülern zu erfassen und damit eventuell einen späteren Beitrag zum Artenschutz dieser Tiere zu leisten.

3.3 Ziele und Fragestellungen der Teilarbeiten A bis C

In der heutigen urbanisierten und medienorientieren Gesellschaft haben Kinder und Jugendliche immer weniger die Möglichkeit sich in der Natur aufzuhalten und sich mit der Natur zu beschäftigen. Negative Folgen wie Aufmerksamkeitsstörungen oder gesundheitliche Schäden treten immer häufiger in Erscheinung. Darüber hinaus kennen Schüler heutzutage kaum noch den Unterschied von einem natürlichen und einem wirtschaftlichen Wald oder können nur selten einheimische Tier- und Pflanzenarten benennen (Lindemann-Matthies 2002). Besonders große Schwierigkeiten treten im Nennen oder Erkennen von gefährdeten einheimischen Tierarten auf (Hermann und Menzel 2013). Aus diesen Gründen wurde eine viertägige Intervention zum Thema Wald, Wolf und Luchs im Nationalpark Bayrischer Wald entwickelt. Diese wurde mit „hands-on“ basierten Unterrichtsmethoden umgesetzt, um den Schülern möglichst direkte und naturnahe Entdeckungen und Erfahrungen des Nationalparks mit seiner Flora und Fauna zu ermöglichen. Ziel war es einerseits auf schul-untypische Weise die bereits in der dritten Klasse des bayrischen Grundschul-Lehrplans durchgenommenen Inhalte zum Thema Wald zu wiederholen und den Wissenserwerb der Schüler auf diese Weise zu steigern. Andererseits sollten durch diese Art der Intervention, positive Lernemotionen geweckt, umweltfreundlichere Einstellungen erzielt und grundlegendes Wissen zu den gefährdeten Tierarten Wolf und Luchs vermittelt werden.

Teilarbeit A

Wie bereits aus der Literatur bekannt, kann Umweltwissen besonders durch direkte Bildungsprogramme signifikant verbessert werden (z. B. Bogner 1998b; Duerden und Witt 2010). Offen blieb dabei jedoch, welche Auswirkungen eine Nachbereitung des Unterrichtsinhaltes langfristig auf das Wissen der Schüler hat. Außerdem wurde bislang der Einfluss von Lernemotionen, hervorgerufen durch ein „hands-on“ gestaltetes Umweltbildungsprogramm, auf den Wissenserwerb der Schüler nicht untersucht. Ziel dieser Teilarbeit war es daher, den Einfluss unterschiedlicher Nachbereitungsmethoden auf den Wissenszuwachs der Schüler zu ermitteln. Angepasst an die sehr offen gestaltete Intervention wurden ebenso zwei schul-untypische Nachbereitungsmethoden gewählt, die den Schülern einmal während des gesamten Bildungsprogrammes (Poster) und zum anderen am Ende des Projektes (Brettspiel) zur Verfügung gestellt wurden. Zusätzlich wurde der Einfluss situationsbedingter Emotionen, die während der Intervention entstehen, auf den Wissenserwerb der Schüler untersucht. Die genauen Erläuterungen der unterschiedlichen Nachbereitungsmethoden finden sich im Methodenteil.
Die konkreten Fragestellungen der Teilarbeit A lauteten:

(1) Haben verschiedene Nachbereitungsmethoden einen unterschiedlich starken Einfluss auf den Wissenszuwachs von Schülern?

(2) Können situationsbedingte Emotionen den Wissenszuwachs von Schülern kurzfristig bzw. langfristig beeinflussen?

Teilarbeit B

Innerhalb der Gesamtstudie war neben dem möglichen Wissenserwerb auch der Einfluss eines erlebnisorientierten Unterrichtsprogramms auf die Einstellungen von besonderem Interesse. Die hierfür verwendete 2-MEV-Skala wurde zwar bereits mehrfach unabhängig bestätigt, jedoch fehlte bislang eine Untersuchung zur Stabilität der zwei Faktoren „Preservation“ (*Naturschutz*) und „Utilization“ (*Natur(aus)nutzung*) über mehrere Testzeitpunkte hinweg. Darüber hinaus wurde ein möglicher Einfluss der beiden Faktoren auf das Wissen der Schüler untersucht.
Folgende konkrete Fragestellungen wurden in der Teilarbeit B gestellt:

(1) Bleibt die zwei Faktorenstruktur der 2-MEV-Skala über drei Testzeitpunkte erhalten?

(2) Können Einstellungen gegenüber dem *Naturschutz* und der *Natur(aus)nutzung* durch die Intervention beeinflusst werden?

(3) Haben hohe *Naturschutz*- und niedrige *Natur(aus)nutzungs*-Präferenzen einen Einfluss auf das Wissen der Schüler?

Teilarbeit C

In Deutschland siedeln sich, wie auch in anderen europäischen Ländern, Wolf und Luchs wieder an. In den skandinavischen Ländern sorgten vor allem Wiederansiedlungsprojekte dieser Tierarten für kontrovers diskutierte Konflikte. Besonders betroffene Landwirte und auf dem Land lebende Personen zeigten häufig negative Einstellungen gegenüber diesen Tieren. Einstellungen und auch Wissen über Wolf und Luchs wurden bisher vor allem unter Kindern und Jugendlichen europaweit nur wenig analysiert. Um den Tieren in Deutschland eine möglichst konfliktfreie Wieder-Einwanderung zu ermöglichen, ist es deshalb wichtig entsprechende Aufklärungsarbeit, besonders innerhalb der jungen Generation, zu leisten. In der Teilstudie C wurden daher im Zusammenhang mit dem z. T. im Nationalpark Bayerischer Wald durchgeführten Wiederansiedlungs-Projekt von Luchsen in Bayern, die Assoziationen gegenüber den Tierarten Wolf und Luchs untersucht. Darüber hinaus wurde mit Hilfe der Wort-Assoziationen ein möglicher Einfluss von Märchen, Mythen und Medien auf die Schüler ermittelt. Die konkreten Forschungsfragen lauteten:

(1) Welche kognitiven Assoziationen und emotionalen Verknüpfungen haben die Schüler zu Wolf und Luchs?

(2) Welchen Einfluss haben Märchen, Mythen und Medien auf die Assoziationen von Schülern gegenüber Wolf und Luchs?

3.4 Methoden

Unterrichtsdesign

Die viertägige Interventionsstudie zum Thema Wald, Wolf und Luchs wurde im Nationalpark Bayerischer Wald durchgeführt. Der thematische Fokus der Studie lag dabei auf dem ursprünglichen Wald mit seiner heimischen Flora und Fauna. Zusätzlich wurden die beiden Tierarten Wolf und Luchs, als wieder angesiedelte Raubtiere in Deutschland, in Hinblick auf ihre Biologie, ihr Verhalten sowie mögliche Vorurteile gegenüber diesen näher betrachtet. Die einzelnen Unterrichtseinheiten über jeweils vier Stunden (vormittags und nachmittags) wurden in Kleingruppen von sieben bis zwölf Schülern unter der Betreuung von ausgebildeten Waldführern durchgeführt. Alle Programmteile waren mit direktem Kontakt zur Natur und aktiven Elementen entwickelt, um die individuelle

Naturverbundenheit der Schüler zur einheimischen Natur zu fördern und die Motivation sich im Freien aufzuhalten zu unterstützen.

Am ersten Tag entdeckten die Schüler auf spielerische Art und Weise ihre nähere Umgebung und lernten dabei u.a. unterschiedliche Baumarten („Bäume erkennen“), einheimische Wildtiere („Welches Tier bin ich?“) oder die Baumkronen („Spiegelgang“) kennen. Innerhalb eines anschließenden Erlebnistages erkundeten die Schüler je nach Jahreszeit ein Hochmoor, ein Feuchtgebiet, dicht bewaldete oder offene Landschaften im Wald. Die Schüler bekamen dort in den Kleingruppen Aufgaben, um ökologische Fragestellungen gemeinsam zu lösen (z. B. Funktionen des Nationalparks, Versteckstrategien des Eichhörnchens). Durch den Besuch des Waldspielgeländes wurden darüber hinaus die individuellen und emotionalen Bereiche der Schüler z. B. durch das Auffinden von Tierspuren oder das Begehen eines Barfußpfades angesprochen. Während einer halb-tägigen Bergwanderung durch einen „abgestorbenen“ Wald wurde den Schülern der Zusammenhang eines flächendeckenden Borkenkäferbefalls von Fichten und bestimmten Wetterbedingungen mit praktischen Beispielen erläutert. Darüber hinaus konnten die Schüler dort die Regeneration eines vom Menschen unberührten Waldes direkt begreifen. In den verschiedenen Ausstellungen des Besucherzentrums des Nationalparks wiederholten die Schüler auf spielerische Weise viele der zuvor behandelten Waldthemen. Ein daran angeschlossener Besuch des Baumwipfelpfades sollte individuelles Wissen über einzelne Baumarten und den Wald im Allgemeinen festigen.

Im Tierfreigelände des Nationalparks hatten die Schüler bei einem Rundgang die Möglichkeit viele einheimische Wildtiere zu beobachten. Der Fokus des Besuches lag jedoch auf den großen Gehegen von Luchs und Wolf. Vor den Gehegen sollten sich die Schüler den Aufbau des Geheges genauer anschauen, um die einzelnen Strukturen im Lebensraum der Tiere zu erkennen. Des Weiteren bekamen sie die Aufgabe, die Tiere zu suchen und über einen längeren Zeitraum zu beobachten. Im Anschluss wurden mit den Waldführern besondere Verhaltensweisen der Tiere diskutiert. Mit Hilfe von speziell angefertigten Informationskarten erarbeiteten die Waldführer mit den Schülern den Jahreszyklus, verbunden mit der Biologie und den Sozialstrukturen der beiden Tierarten. Anschließend wurden den Schülern durch Rollenspiele das Jagdverhalten und das Sozialsystem nochmals spielerisch verdeutlicht (Tab. 1).

Tabelle 1: Wochenprogramm der Interventionsstudie

	Montag	Dienstag	Mittwoch	Donnerstag	Freitag
Vormittag	Anreise	Erlebnis--tag	Waldspiel-gelände (Tierspuren, Barfußpfad)	Besucher-zentrum (Themen des Waldes an Modellen)	Abreise
Nachmittag	Erkundung der näheren Umgebung des Jugend-waldheims	Tierfrei-gelände (Wolf und Luchs)	Bergwan-derung („abge-storbener“ Fichtenwald)	Baumwipfel-pfad (Baumarten vertiefen)	

Abends wurden die Schüler beauftragt ihre Tageserlebnisse in einem speziell dafür angefertigten individuellen Tagebuch festzuhalten. Um die Schüler bei ihren Erinnerungen zu unterstützen konnten sie sich jederzeit drei aushängende Poster mit den Themen Wald, Wolf und Luchs anschauen (Nachbereitungsmethode 1). Am Ende des viertägigen Programmes führte ein Teil der Schüler zusätzlich ein Brettspiel durch, dass die Inhalte der Poster wiederholte (Nachbereitungsmethode 2). Das Spiel war bewusst mit kooperativen und kompetitiven Inhalten gestaltet, um einen zusätzlich emotionalen Effekt bei den Schülern hervorzurufen.

Datenerhebung und -auswertung der Teilarbeiten A bis C

Die Teilnahme der Schüler an der Gesamtstudie war freiwillig und erfolgte erst nach Anmeldung und Zustimmung der Eltern und der Lehrkraft. Für alle Teilarbeiten wurde die gleiche Stichprobe verwendet, die aber auf Grund verschiedener Zielgruppen variierte. Alle Daten wurden innerhalb eines quasi-experimentellen Designs mittels Papier-Bleistift-Test zu drei Testzeitpunkten (Vortest: etwa 2 Wochen vor der Intervention, Nachtest: am Ende der Intervention, Behaltenstest: 4-6 Wochen nach der Intervention) erhoben.

Teilarbeit A

In der ersten Teilstudie nahmen 298 Schüler (52,3 % weiblich; Altersdurchschnitt = 10,03 ± 0,87) der vierten und fünften Klasse aus bayrischen Grund- und Mittelschulen teil. Davon führten 170 Schüler die Nachbereitungsmethode 1 (Gruppe N-1: Poster) und 128 Schüler die Nachbereitungsmethode 1 und 2 (Gruppe N-2: Poster und Spiel) durch (Abb. 1). Um einen Lerneffekt allein durch den verwendeten Wissensfragebogen zu vermeiden, diente eine zweite Gruppe von 60 Schülern (Grund- und Mittelschule; 41,8 % weiblich; Altersdurchschnitt = 9,97 ± 0,84), die nicht an der Intervention teilnahm, als Kontrollgruppe.

Die kognitive Leistung der Schüler wurde durch einen Wissenstest mit 15 Multiple-Choice-Fragen (4 Distraktoren, jeweils eine Antwort richtig, siehe Anhang) ermittelt. Die situationsbedingten Emotionen wurden über eine fünfstufige Likert-Skala (5 = „stimmt genau“ – 1 = „stimmt überhaupt nicht“) in einem Test mit 9 Items erfragt (siehe Anhang). Die Anordnung der Fragen sowie der Antwortmöglichkeiten wurden für jeden Testzeitpunkt randomisiert. Der Emotionstest wurde nur im Nachtest und direkt nach der Durchführung des Brettspiels ausgefüllt. Die Reliabilität des Wissenstests (Nachtest) wies ein Cronbach’s α von 0,51 auf, was für Zwischengruppenvergleiche von *ad hoc*-Tests als ausreichend gilt (Lienert und Raats 1994). Die Reliabilitätswerte zu den situationsbedingten Emotionen lagen für Langweile bei 0,56, für Interesse bei 0,78 und für Wohlbefinden bei 0,79.

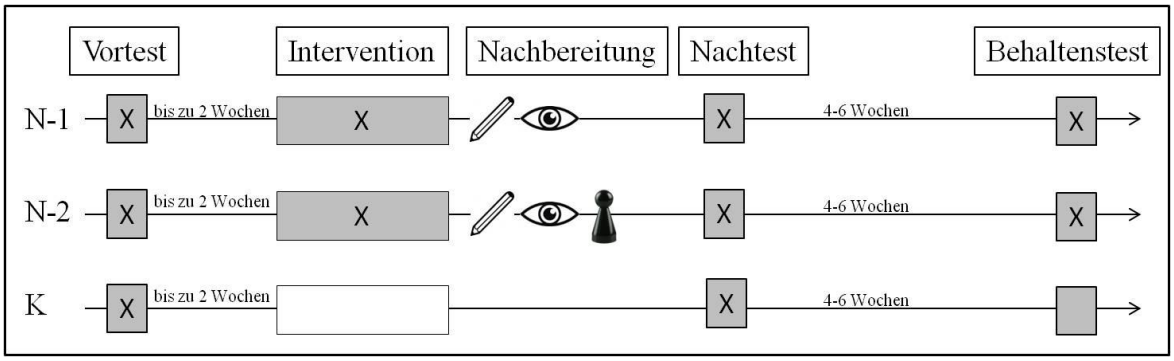


Abbildung 1: Studiendesign. (Anmerkung: N-1: Nachbereitungsgruppe 1; N-2: Nachbereitungsgruppe 2; K: Kontrollgruppe; X: Teilnahme; ✎: individuelles Tagebuch (täglich verfügbar); 👁: Poster (täglich verfügbar); ♟: Brettspiel (am letzten Tag verfügbar))

Um die Qualität des Wissenstests zu analysieren, wurde das Rasch-Model für dichotome Items angewendet. Dieses probabilistische Model beschreibt die Wahrscheinlichkeit der richtigen Antworten als Funktion der Personenfähigkeit und der Itemschwierigkeit (Bond und Fox 2007). Für das Raschmodel wurden die Mittelwerte (pro Testzeitpunkt und Schüler, 1 = richtige Antwort, 0 = fehlende oder falsche Antwort) mit dem Programm QUEST berechnet (Adams und Khoo 1996). Die anschließende Auswertung der

Wissenswerte erfolgte durch ein lineares, gemischtes Model (R-Funktion "lmer"; Paket "lme4"). Dieser Modelltyp ermöglicht eine Berücksichtigung von Wiederholungsmessungen (der gleiche Schüler wurde mehrfach befragt) und eventuell möglichen Unterschieden zwischen den Schulen durch Einbindung von zwei Zufallseffekten in der Modellformel (Bolker et al. 2009). Der paarweise Vergleich zwischen den beiden Nachbereitungs-Gruppen (N-1 und N-2) wurde mit der Funktion „glht“ im R-Paket "multcomp“ berechnet, die eine simultane Adjustierung der p-Werte bei Mehrfachvergleichen vornimmt. Alle weiteren statistischen Auswertungen wurden mit dem Programm IBM SPSS Statistics 21 vorgenommen. Nach dem zentralen Grenzwertsatz wurde auf Grund der hohen Teilnehmerzahl von normalverteilten Daten ausgegangen und parametrisch (Wilcoxon und Mann-Whitney-U-Test) getestet (Wilcox 2012).

Teilarbeit B

Die zweite Studie wurde mit 333 Schülern (54, 2 % weiblich; Altersdurchschnitt = 10,02 ± 0,84) aus der vierten und fünften Klasse der bayrischen Grund- und Mittelschule durchgeführt.

Für diese Teilstudie wurden zusätzlich zur kognitiven Leistung der Schüler aus Teilstudie A, die Umwelteinstellung der Schüler mithilfe der 2-MEV (2 Major Environmental Values) - Skala erhoben. Diese setzt sich ursprünglich aus jeweils 10 Items der beiden Faktoren „Preservation“ (*Naturschutz*) und „Utilization“ (*Natur(aus)nutzung*) zusammen. Für die vorliegende Studie wurde die Skala an die kognitiven Kapazitäten der Schüler angepasst und auf die insgesamt 16 höchstladenden Items reduziert. Die Antwortmöglichkeiten der Schüler bezogen sich auf eine fünfstufige Likert-Skala („stimmt genau“ – „stimmt überhaupt nicht“). Die Cronbach‘s α-Werte der Reliabilität der 2-MEV-Skala (Nachtest) lagen bei 0,72 für den Faktor *Natur(aus)nutzung* und bei 0,87 für den Faktor *Naturschutz*.

Die statistische Auswertung der Daten erfolgte mit dem Programm IBM SPSS Statistics 21. Zur Ermittlung der 2-Faktorenstruktur wurde eine Hauptachsen-Faktoranalyse mit dem Kaiser-Meyer-Olkin Kriterium gerechnet. Für alle weiteren Berechnungen wurden die Faktorenwerte verwendet. Aufgrund der nicht normalverteilten Daten wurde nicht-parametrisch (Friedman-Test, Spearman’s Roh Korrelationen) getestet.

Teilarbeit C

An der dritten Teilstudie nahmen 311 Schüler (43,7 % weiblich; Altersdurchschnitt = 10,03 ± 0,82) der vierten und fünften Klasse der bayrischen Grund- und Mittelschule teil.

In diesem Test wurden die Schüler aufgefordert jeweils sechs Begriffe, die ihnen spontan zu dem Stimulus-Wort Wolf und zu dem Stimulus-Wort Luchs einfallen, zu notieren. Alle Assoziationen zu jedem Stimulus-Wort wurden getrennt voneinander mit der qualitativen Inhaltsanalyse induktiv und iterativ analysiert (Mayring 2004). Dadurch ergab sich ein

Kategoriensystem auf drei Ebenen. Auf der ersten Kategorien-Ebene wurden alle gegebenen Assoziationen der Schüler zu insgesamt 176 Kategorien für das Stimulus-Wort Wolf und 194 Kategorien für das Stimulus-Wort Luchs zusammengefasst. In der zweiten Kategorien-Ebene wurden diese Kategorien für das Stimulus-Wort Wolf weiter zu 52 und für das Stimulus-Wort Luchs weiter zu 53 Kategorien komprimiert. In der dritten Kategorien-Ebene blieben noch 24 Kategorien für das Stimulus-Wort Wolf und 26 Kategorien für das Stimulus-Wort Luchs übrig. Für die allgemeine Auswertung wurden die, über die Testzeitpunkte signifikanten Kategorien der Ebene drei verwendet, für detailliertere Analysen die der Kategorien-Ebene eins.

Alle statistischen Auswertungen wurden mit dem Programm IBM SPSS Statistics 21 durchgeführt. Um die Objektivität der Kategorien zu ermitteln, wurden die Intra- und Inter-Rater Reliabilität mit dem Koeffizienten Cohen's Kappa von ungefähr 12 % der Kategorien-Ebenen berechnet (Cohen 1968). Auf Grund der nicht-normalverteilten Daten wurden alle Auswertungen nicht-parametrisch (Friedman-Test, Wilcoxon-Test) durchgeführt.

3.5 Ergebnisse und Diskussion

Teilarbeit A

Der Einfluss eines Bildungsprogrammes auf den Wissenserwerb der Schüler ist eines der wichtigsten Schwerpunkte in der didaktischen Forschung, da er als Grundlage für alle weiteren Entwicklungsmöglichkeiten wie z. B. Umwelteinstellungen vorausgesetzt wird. In der Teilarbeit A konnte ein signifikanter Wissenszuwachs durch das zuvor beschriebene Unterrichtsprogramm erreicht werden. Ähnliche Ergebnisse konnten auch in früheren Studien gefunden werden, deren Ziel die Begeisterung der Schüler für die Natur war (Falk und Balling 1982; Bogner 1998b; Wells 2000). Lindemann-Matthies (2002) geht sogar noch weiter und mutmaßt, dass solche Umweltbildungsprogramme essentiell sind, um die Wissenslücken unserer Schüler bezüglich der einheimischen Tier- und Pflanzenwelt zu schließen. Das durchgeführte Programm mit seinen gezielt ausgewählten Inhalten zu Pflanzen und Tieren einheimischer Wälder, konnte sowohl kurz- als auch langfristig den Wissenserwerb der Schüler steigern. Speziell der Wissenszuwachs bezüglich der beiden sich wiederansiedelnden Raubtiere Wolf und Luchs könnte sehr vielversprechend sein. Bath und Farmer (2000) wiesen beispielsweise nach, dass ein höheres Wissen über Raubtiere, zu positiveren Einstellungen gegenüber diesen bei Schülern führt. Die in dieser Studie durchgeführten Beobachtungen der Tiere in ihrem natürlichen Umfeld und die zusätzlichen Rollenspiele stellten Wolf und Luchs mit ihren natürlichen Eigenschaften im

Gegensatz zu den negativen Bildern in Märchen und Mythen dar. Dadurch wurde das Interesse der Schüler gegenüber diesen Tieren geweckt, was sich in Zukunft auch in einer aktiven Teilnahme am Tierschutz dieser Arten zeigen könnte.
Die Qualitätsanalyse des verwendeten Wissenstests mittels Rasch-Model zeigte eine leichte Verschiebung in der Anordnung der Items bezüglich ihrer Schwierigkeit gegenüber der Personenfähigkeit. Das bedeutet es wurden mehr leichte Items, verglichen mit der Personenfähigkeit der Schüler verwendet. Deshalb wurden bereits im Vortest durchschnittlich acht von 15 Fragen von den Schülern richtig beantwortet. Dieses hohe Vorwissen führte dazu, dass Schüler ihr Wissen nur minimal steigern konnten. In folgenden Studien sollte dies berücksichtigt werden.

Die angewandten Nachbereitungsmethoden erwiesen sich beide als zusätzlicher Einflussfaktor für den Wissenserwerb der Schüler. Es konnte ein signifikant höherer Zuwachs im Wissen festgestellt werden, wenn die Schüler sowohl die Nachbereitungsmethode mit den Postern, als auch mit dem Brettspiel durchführten (Gruppe: N-2). Beide Nachbereitungsmethoden wurden im Einklang an das sehr offen strukturierte und mit direkten Erfahrungen verknüpfte Bildungsprogramm entworfen. Daher dienten sie als schul-untypische Nachbereitungsformen zur Wiederholung der im Programm vorkommenden Bildungsinhalte. Dabei erwiesen sich die doppelte Wiederholung und der emotionssteigernde und kompetitive Charakter des Spieles als besonders effektiv. Bereits in anderen Studien konnte festgestellt werden, dass durch einen Wettbewerb zwischen zwei Gruppen ein positiver Vorteil für die Teilnehmer beim Lernen entsteht. Die Schüler arbeiten dadurch besser zusammen und haben zusätzlich das Gefühl über einen höheren Wissenspool durch die anderen Gruppenmitglieder zu verfügen (Slavin 1980; Johnson und Johnson 1991). Das zusätzlich kurzfristig und signifikant mit dem Wissenszuwachs korrelierte Wohlbefinden der Schüler, zeigt darüber hinaus, dass diese Form der Nachbereitung sowohl das Lernen, als auch die positiven Emotionen der Schüler fördert.

Betrachtet man die situationsbedingten Emotionen im Verlauf einer ganzen Woche, so zeigte sich ein kurzfristiger signifikanter Einfluss des Wohlbefindens auf den Wissenszuwachs. Diese Ergebnisse bestätigen, dass während der Intervention subjektiv positive Gefühle wie das Wohlbefinden als hilfreiche Variable bezüglich des Lernprozesses fungieren können (Randler et al. 2011). Langfristig wirkte sich auch das Interesse der Schüler signifikant auf den Wissenserwerb aus. Unterrichtsprogramme (wie auch in der vorliegenden Studie), die sehr erlebnisorientiert aufgebaute sind und viele aktive und direkte Erfahrungen mit der Natur ermöglichen, rufen positive Gefühle bei Schülern hervor und steigern somit den Lernerfolg (Fröhlich et al. 2013).

Teilarbeit B

Aufbauend auf der ersten Studie wurde in Teilstudie B mit Hilfe der 2-MEV-Skala der Einfluss von Umwelteinstellungen zu *Natur(aus)nutzung* und *Naturschutz* auf den Wissenserwerb von Schülern untersucht. Wie in vorherigen Studien, konnte die dichotome Struktur der Skala bestätigt werden (Johnson und Manoli 2008; Boeve-de Pauw und van Petegem 2011; Milfont und Duckitt 2004; Liefländer und Bogner 2014). Auch die reduzierte Form mit nur 16 Items (statt der ursprünglich 20 Items) der hier angewendeten Skala wies diesen Aufbau auf (Schneller et al. 2013). Darüber hinaus wurde die Skala erstmals zu mehren Testzeitpunkten eingesetzt und zeigte auch hier, bei gleichbleibender Verteilung der Ladungen auf einem Faktor, immer wieder die zweidimensionale Struktur.

Obwohl in vorherigen Studien mit einer Interventionsdauer von ca. vier Tagen bereits ein Einfluss von Bildungsprogrammen auf die Einstellungen der Schüler gemessen wurde (Bogner 1998b; 1999; Johnson und Manoli 2008), zeigte sich entgegen unseren Erwartungen in der vorliegenden Studie keine diesbezügliche Veränderung. Ein wichtiger Einflussfaktor liegt hierbei möglicherweise in der Vermittlung der dargestellten Inhalte. In vorherigen Programmen wurden Umweltthemen gezielt und detailliert angesprochen und erreichten dadurch eine Verbesserung der *Naturschutz*-Werte. Das vorliegende Programm dagegen beschäftigte sich mehr mit der Vermittlung von Faktenwissen z.B. bezüglich der heimischen Natur, was die Einstellungen der Schüler nicht beeinflusste.

Ebenso zeigten sich im Gegensatz zu anderen Studien keine Geschlechtsunterschiede, weder in den Präferenzen zur *Natur(aus)nutzung* noch zum *Naturschutz*. Hier scheinen verschiedene Einflussfaktoren wie beispielsweise die Art des Programmes oder der schulische Hintergrund eine entscheidende Rolle zu spielen (Bogner 1999; 2002; Bogner und Wiseman 2006; Boeve-de Pauw und van Petegem 2011; Fremerey und Bogner 2015). Im Falle der vorgelegten Teilstudie B kann man daher davon ausgehen, dass die Intervention gleichermaßen für beide Geschlechter geeignet ist.

Im Zusammenhang von Umwelteinstellungen und Wissen zeigte sich über alle Testzeitpunkte eine signifikant negative Korrelation zwischen dem Wissen und den *Natur(aus)nutzungs*-Werten[3] und eine signifikant positive Korrelation mit den *Naturschutz*-Werten[4]. Letztere konnten nach der Durchführung einer Bonferroni-Korrektur im Vortest nicht mehr nachgewiesen werden. Als mögliche, verantwortliche Einflussfaktoren wurden wieder die Art und die Inhalte der Bildungseinheit vermutet. Vergleichbare Ergebnisse

[3] Hohe Natur(aus)nutzungs-Werte bedeuten, dass der Schüler die Natur eher ausnutzt.

[4] Hohe Naturschutz-Werte bedeuten, dass der Schüler die Natur eher schützt.

wurden beispielsweise nach einer ähnlichen Intervention von Bogner (1998b) gefunden. Im Gegensatz dazu, konnte bei der Überprüfung der Umwelteinstellungen von Schülern einer flämischen Eco-Schule zwar ebenso ein signifikant negativer Zusammenhang mit den *Natur(aus)nutzungs*-Werten festgestellt werden, aber ein signifikant positiver Zusammenhang wurde nur zwischen Umweltemotionen und *Naturschutz* gefunden (Boeve-de Pauw und van Petegem 2011; Sellmann und Bogner 2013). Dies könnte auch die erst im Nachtest auftretende signifikant positive Korrelation zwischen Wissen und Naturschutz in der vorliegenden Studie erklären. Zu Beginn der Studie hatten die Schüler noch keinen emotionalen Bezug zur Natur aufgebaut und zeigten deshalb nur positive Einstellungen gegenüber der *Natur(aus)nutzung*, der sie auch häufig im Alltag begegnen. Nach der affektiv aufgebauten Intervention konnten aber auch die Emotionen der Schüler angesprochen werden, wodurch sich eine positive Einstellung gegenüber dem Naturschutz einstellte, der sich auf den Wissenserwerb der Schüler auswirkte.

Teilarbeit C

Durch die Teilarbeit C wurden erste Einblicke in die Assoziationen von Schülern gegenüber den sich wieder ansiedelnden Raubtieren Wolf und Luchs in Deutschland erhalten. In der dritten Kategorienebene konnten letztendlich 14 Kategorien dem Stimulus-Wort *Wolf* und 10 Kategorien dem Stimulus-Wort *Luchs* zugeordnet werden, die sich signifikant über die drei Testzeitpunkte unterschieden. Dadurch wurde die Effizienz einer kurzen Unterrichtseinheit bestätigt (ca. 4 Stunden, Sellmann und Bogner 2013). Zusätzlich zeigten die unterschiedlichen Kategorien, dass die Assoziation der Schüler viele Lebensbereiche der Tiere beschreiben. Für diese Studie C wurden aber nur die Kategorien der Ebene-3 betrachtet, die sich zum einen auf das Thema der Wiederansiedlung und zum anderen auf Inhalte der Intervention bezogen. Für das Stimulus-Wort *Wolf* waren dies die Kategorien: *Gefährlichkeit*, *Prädation*, *tierische Eigenschaften*, *Vorkommen* und *Sozialsystem*. Für das Stimulus-Wort *Luchs* wurden die folgenden Kategorien genauer analysiert: *Gefährlichkeit*, *Prädation*, *Lebensraum*, *tierische Eigenschaften* und *Sozialsystem*.

Die Kategorie *Gefährlichkeit* zeigte bei beiden Stimuli-Wörtern eine höhere Anzahl der Assoziationen im Vortest. Besonders der Wolf wurde als gefährliches und aggressives Tier beschrieben, was der typischen Darstellung in vielen Märchen, Mythen sowie den Medien entspricht (Zimen 2003; Houston et al. 2010). Obwohl für Jugendliche in einer britischen Studie mehr positive Einstellungen gegenüber Wölfen gefunden wurden (Bath und Farmer 2000), zeigt das Ergebnis des Vortests, dass unsere Schüler offensichtlich immer noch von dem negativen Bild des Wolfes aus Märchen und Medien geprägt sind. Auch der Luchs wurde im Vortest als gefährlich beschrieben, wobei hier weniger Assoziationen genannt wurden als beim Stimulus-Wort *Wolf*. Da zu Einstellungen von

Kindern oder Jugendlichen gegenüber dem Luchs noch keine Untersuchungen durchgeführt wurden und Wiederansiedlungs-Projekte in Deutschland immer mit sehr positiven Medienberichten begleitet wurden, haben Schüler dieser Studie den Luchs offenbar mit anderen großen Raubkatzen verglichen und den Luchs daher als gefährlich eingestuft. Das Beobachten der Tiere in ihrem natürlichen Umfeld und die intensiven Diskussionen mit den Waldführern faszinierten die Schüler dagegen und zeigten die Tiere in einem neuen Zusammenhang. Dadurch konnte die Anzahl der Assoziation in der Kategorie *Gefährlichkeit* signifikant und langfristig für beide Stimuli-Wörter reduziert werden.

Die Kategorie *Prädation*, die alle Jagdverhaltensweisen wie auch die Tarnfähigkeit der Tiere beinhaltet, wurde ebenso für beide Stimuli-Wörter genannt. Im Vortest war die Anzahl der Assoziationen zu dieser Kategorie noch relativ gering, was darauf hinweist, dass nur wenige Schüler über diese Verhaltensweisen informiert waren. Nach der Intervention stieg die Anzahl der Assoziationen signifikant und langfristig an, was auf einen Lerneffekt durch die Intervention hindeutet. Besonders die Rollenspiele zum Jagdverhalten der Tiere zeigten den Schülern, dass auch Tiere Übung brauchen, um erfolgreich zu sein. Möglicherweise bleiben solch affektive Spiele auch bis ins Erwachsenenalter in der Erinnerung erhalten und ermöglichen dadurch ein besseres Verständnis zum Beispiel für Angriffe von Raubtieren auf Nutztiere (Sebba 1991).

Für die Kategorie *Lebensraum* wurde ein signifikant langfristiger Anstieg der Assoziationsanzahl für das Stimulus-Wort *Luchs* gefunden. Kurzfristig wurden nur wenig mehr Assoziationen in dieser Kategorie als im Vortest genannt. Da die Lebensraumstrukturen des Luchses für Schüler relativ einfach zu merken sind, vermuten wir, dass den Schülern direkt nach der Intervention eher neuere und komplexere Assoziationen im Gedächtnis blieben. Nach vier bis sechs Wochen dagegen konnten sich die Schüler besser an die einfacheren Assoziationen erinnern und die Anzahl der Assoziationen bezüglich der Kategorie *Lebensraum* stiegen entsprechend an.

Die schon im Vortest hohe Anzahl der Assoziationen zu *tierischen Eigenschaften* stieg bei beiden Stimuli-Wörtern kurzfristig signifikant an. Langfristig fiel die Anzahl der Assoziationen aber unter die Anzahl des Vortests ab. Auch in einer anderen Studie wurde das meiste Wissen zu biologischen Charaktereigenschaften gefunden (Kellert 1985). Komplexere Zusammenhänge wie zum Beispiel der Gefährdungsstatus der Tiere waren gerade für jüngere Schüler schwieriger abrufbar (Bath und Farmer 2000; Hermann und Menzel 2013).

Obwohl die Anzahl der Assoziationen in der Kategorie *Vorkommen* für das Stimulus-Wort *Wolf* niedrig war, war sie für diese Studie von besonderem Interesse und wurde in die Unterkategorien *Region*, *Vorkommen* und *Gefährdungsstatus* unterteilt. In der Kategorie *Region* wurden erst nach der Intervention drei Regionen (Sachsen, Bayern, Bayerischer Wald) als mögliche Lebensräume der Wölfe genannt. Die Regionen Bayern und Bayerischer Wald wurden auf Grund der Intervention mit dem *Wolf* in Verbindung gebracht. Sachsen gilt als tatsächlicher Lebensraum von Wölfen und war somit die einzig richtige Assoziation in dieser Kategorie. Auch für die Kategorie *Vorkommen* wurden auch nur wenige Assoziationen genannt, obwohl den Schülern eine Karte über die Verbreitung der Wölfe gezeigt wurde. Sie scheinen jedoch Schwierigkeiten zu haben, sich an die Verbreitung der Tiere zu erinnern. In der Kategorie *Gefährdungsstatus* fiel auf, dass die Anzahl der Assoziationen auch hier nur kurzfristig signifikant anstieg. Dies erklärt, dass die Diskussion mit den Waldführern für die Schüler lehrreich waren, aber dieses Thema für jüngere Schüler zu komplex erscheint, um sich langfristig daran zu erinnern (Kellert 1985; Hermann und Menzel 2013).

Auch die Kategorie *Sozialsystem* wurde für beide Stimuli-Wörter genauer betrachtet und in die Unterkategorien *Einzelgänger* und *Rudel* unterteilt. Dabei fiel auf, dass bereits im Vortest ein Großteil der Schüler die beiden Tierarten ihren richtigen Sozialsystemen (Wolf: Rudeltier, Luchs: Einzelgänger) zuordnen konnten. Nach der Intervention war sowohl ein kurzfristig wie auch langfristig signifikanter Anstieg der Assoziationsanzahl für beide Stimuli-Wörter zu verzeichnen. Dies weist erneut darauf hin, dass ein geringes Vorwissen durch ein solch erlebnisorientiertes und aktives Programm leicht verbessert werden kann und deshalb häufiger besonders im außerschulischen Unterricht umgesetzt werden sollte.

3.6 Schlussfolgerung und Ausblick

Das für diese Studie gewählte Programm mit seinem sehr erlebnisorientierten und affektiven Charakter erreichte bei der Zielgruppe jüngerer Schüler eine Förderung positiver Lernemotionen und einen damit verbundenen kognitiven Lernerfolg. Situationsbedingte Emotionen tragen durchaus zum Wissenserwerb bei und sollten deshalb auch im konventionellen Unterricht gefördert werden. Geeignete Unterrichtseinheiten hierfür sollten eigene direkte Erfahrungen erlauben. Besonders außerschulische Lernorte lassen viele Möglichkeiten offen, eine solche Unterrichtseinheit durchzuführen. Wie in dieser Studie gezeigt wurde, können auch affektive Methoden in der Nachbereitung situationsbedingte Emotionen hervorrufen und sich langfristig positiv auf den Lernerfolg auswirken. Dennoch bedarf es, auf Grund der bisher nur wenigen Studien bezüglich positiver Lernemotionen auf den Lernerfolg, weiterer Forschung.

Die Umwelteinstellungen von Schülern hängen von vielen Faktoren ab, wie in dieser Studie erneut bestätigt werden konnte. Dennoch sollten bei der Konzipierung von Unterrichtsangeboten die Inhalte gezielt auf die gewünschten Umwelteinstellungspräferenzen abgestimmt werden. Im Idealfall fließen dabei sowohl Betrachtungsweisen der Naturnutzung wie auch des Naturschutzes ein. Konkrete Beispiele helfen dabei besonders jüngeren Schülern. Eine reine Vermittlung von Faktenwissen führt dagegen nicht zum gewünschten Umdenken, wie diese Studie zeigen konnte. Dennoch bleibt auch hier nicht auszuschließen, dass andere Faktoren wie z. B. die Dauer oder Art des Umweltbildungsprogrammes einen Einfluss auf Einstellungsänderungen haben können.

Erhobene Assoziationen bezüglich Wolf und Luchs aus dieser Studie konnten erste Hinweise über die Wahrnehmung bezüglich dieser Tiere geben. Zunächst sind erhebliche Wissenslücken auffällig, sowie eine konsistent negative Darstellung der Tiere. Unterricht im Allgemeinen sollte sich daher der Lebensweise und Biologie der Raubtiere intensiver annehmen. Unterrichtseinheiten sollten die Beziehung Mensch und Wolf beziehungsweise Luchs von deren Ausrottung bis hin zur natürlichen und anthropogenen Wiederansiedlung sowie die natürliche Lebensweise richtig darstellen. Begleitende Unterrichtsbesuche zu großen, möglichst naturnahen Tiergehegen und damit verbundenen Beobachtungen erleichtern dabei eine realistische Vorstellung über das natürliche Leben der Tiere. Zusätzlich kann der Kontakt mit Wissenschaftlern oder mit Wiederansiedlungsprojekten einen lebensnahen Bezug zu den Tieren unterstützen und dadurch intensiver für dieses Thema sensibilisieren. In diesem Zusammenhang fehlt derzeit dem bayrischen Grundschul-Lehrplan der Bezug zu gefährdeten Tierarten, die auch durch unsere Lebensweise und den immensen Anstieg unserer Bevölkerungszahlen, betroffen sind.

Zusammenfassend konnte die Studie zeigen, dass der erlebnisorientierte Zugang am außerschulischen Lernort Nationalpark sowohl kognitive, als auch affektive Bereiche der Schüler angesprochen hat und sie für aktuelle Umweltthemen der einheimischen Natur sensibilisieren konnte.

4. Literaturverzeichnis der Zusammenfassungen

Adams, R. J., & Khoo, S. T. (1996). *Acer Quest. The interactive test anaylsis system*. Camperwell, Australia: Acer Press.

Allen, M. (2010). Learner error, affectual stimulation, and conceptual change. *Journal of Research in Science Teaching, 47*(2), 151–173.

Bath, A. J., & Farmer, L. (2000). *Europe's carnivores - a survey of children's attitudes towards wolves, bears and otters*. Godalming, UK: World Wildlife Found.

Bjerke, T., Reitan, O., & Kellert, S. R. (1998). Attitudes toward wolves in southeastern Norway. *Society & Natural Resources, 11*(2), 169–178.

Boeve-de Pauw, J., & van Petegem, P. (2011). The Effect of Flemish Eco-Schools on Student Environmental Knowledge, Attitudes, and Affect. *International Journal of Science Education, 33*(11), 1513–1538.

Bogner, F. X. (1998a). Environmental perceptions of Irish and Bavarian pupils: an empirical study. *The environmentalist, 18*, 27–38.

Bogner, F. X. (1998b). The influence of short-term outdoor ecology education on long-term variables of environmental perspective. *The Journal of Environmental Education*, *29*(4), 17–29.

Bogner, F. X. (1999). Empirical evaluation of an educational conservation programme introduced in Swiss secondary schools. *International Journal of Science Education, 21*(11), 1169–1185.

Bogner, F. X. (2002). The influence of a residential outdoor education programme to pupil's environmental perception. *European Journal of Psychology of Education, 17*(1), 19-34.

Bogner, F. X., & Wiseman, M. (1997). Association tests and outdoor ecology education. *European Journal of Psychology of Education, 8*(1), 89-102.

Bogner, F. X., & Wiseman, M. (1999). Toward measuring adolescent environmental perception. *European Psychologist, 4*(3), 139–151.

Bogner, F. X., & Wiseman, M. (2002). Environmental perception: Factor profiles of extreme groups. *European Psychologist, 7*(3), 225–237.

Bogner, F. X., & Wiseman, M. (2004). Outdoor Ecology Education and Pupils' Environmental Perception in Preservation and Utilization. *Science Education International, 15*(1), 27–48.

Bogner, F. X., & Wiseman, M. (2006). Adolescents' attitudes towards nature and environment: Quantifying the 2-MEV model. *Environmentalist, 26*(4), 247–254.

Bolker, B. M., Brooks, M. E., Clark, C. J., Geange, S. W., Poulsen, J. R., Stevens, M. H. H., & White, J.-S. S. (2009). Generalized linear mixed models: a practical guide for ecology and evolution. *Trends in Ecology & Evolution, 24*(3), 127–135.

Bond, T. G., & Fox, C. M. (2007). *Applying the Rasch Model. Fundamental measurement in the human sciences*. New York, London: Taylor & Francis Group.

Cohen, J. (1968). Weighted Kappa: Nominal scale agreement with provision for scaled disagrement or partial credit. *Psychological Bulletin, 70*(4), 213–220.

Derakshan, N., & Eysenck, M. W. (2010). Introduction to the special issue: Emotional states, attention, and working memory. *Cognition and Emotion, 24*(2), 189–199.

Dettmann-Easler, D., & Pease, J. L. (1999). Evaluating the Effectiveness of Residential Environmental Education Programs in Fostering Positive Attitudes Toward Wildlife. *The Journal of Environmental Education, 31*(1), 33–39.

Dillon, J., Rickinson, M., Teamey, K., Morris, M., Choi, M. Y., Sanders, D., & Benefield, P. (2006). The value of outdoor learning: evidence from research in the UK and elsewhere. *School Science Review, 87*(320), 107–112.

Drissner, J., Haase, H.-M., & Hille, K. (2010). Short-term Environmental Education - Does it work? - An evaluation of the 'Green Classroom'. *Journal of Biological Education, 44*(4), 149–155.

Duerden, M. D., & Witt, P. A. (2010). The impact of direct and indirect experiences on the development of environmental knowledge, attitudes, and behavior. *Journal of Environmental Psychology, 30*(4), 379–392.

Faber Taylor, A., & Kuo, F. E. (2009). Children with attention deficits concentrate better after walk in the park. *Journal of Attention Disorders, 12*(5), 402–409.

Faber Taylor, A., Kuo, F. E., & Suvillan, W. C. (2002). Views of nature and self-discipline: evidence from inner city children. *Journal of Environmental Psychology, 22*, 49–63.

Falk, J. H., & Balling, J. D. (1982). The Field Trip Milieu: Learning and Behavior as a Function of Contextual Events. *The Journal of Educational Research, 76*(1), 22–28.

Fančovičová, J., & Prokop, P. (2011). Plants have a chance: outdoor educational programmes alter students' knowledge and attitudes towards plants. *Environmental Education Research, 17*(4), 537–551.

Fremerey, C., & Bogner, F. X. (2015). Cognitive learning in authentic environments in relation to green attitude preferences. *Studies in Educational Evaluation, 44*, 9–15.

Fröhlich, G., Sellmann, D., & Bogner, F. X. (2013). The influence of situational emotions on the intention for sustainable consumer behaviour in a student-centred intervention. *Environmental Education Research, 19*(6), 747–764.

Gläser-Zikuda, M., Fuß, S., Laukenmann, M., Metz, K., & Randler, C. (2005). Promoting students' emotions and achievement – Instructional design and evaluation of the ECOLE-approach. *Learning and Instruction, 15*(5), 481–495.

Hammerman, W. M. (1980). *Fifty years of resident outdoor education:1930-1980*. Indiana: American Camping Association.

Hermann, N., & Menzel, S. (2013). Threat Perception and Attitudes of Adolescents Towards Re-Introduced Wild Animals: A qualitative study of young learners from affected regions in Germany. *International Journal of Science Education, 35*(18), 3062–3094.

Hirsh, K. W., & Tree, J. J. (2001). Word association norms for two cohorts of British adults. *Journal of Neurolinguistics, 14*(1), 1–44.

Houston, M. J., Bruskotter, J. T., & Fan, D. (2010). Attitudes towards wolves in the US and Canada: A content analysis of the print news media, 1999-2008. *Human Dimensions of Wildlife, 15*, 389–403.

Janssen, I., Katzmarzyk, P. T., Boyce, W. F., Vereecken, C., Mulvihill, C., Roberts, C., Currie, C., & Pickett, W. (2005). Comparison of overweight and obesity prevalence in school-aged youth from 34 countries and their relationships with physical activity and dietary patterns. *Obesity reviews, 6*, 123–132.

Johnson, B., & Manoli, C. C. (2008). Using Bogner and Wiseman's Model of Ecological Values to measure the impact of an earth education programme on children's environmental perceptions. *Environmental Education Research, 14*(2), 115–127.

Johnson, D. W., & Johnson, R. T. (1991). *Learning together and alone*. *Comparative, competitive, and individualistic learning*. Needham Heights, Massachusetts: Allyn and Bacon.

Kellert, S. R. (1985). Attitudes Toward Animals: Age-Related Development among Children. *Journal of Environmental Education*, *16*(3), 29-39.

KMK - Sekretariat der Ständigen Konferenz der Kultusminister der deutschen Länder in der Bundesrepublik Deutschland (2005*). Bildungsstandards im Fach Biologie für den mittleren Bildungsabschluss – Beschluss vom 16.12.2004*. München: Wolters Kluwer GmbH.

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research, 8*(3), 239–260.

Leeming, F. C., Dwyer, W. O., Porter, B. E., & Cobern, M. K. (1993). Outcome Research in Environmental Education: A Critical Review. *The Journal of Environmental Education, 24*(4), 8–21.

Liefländer, A. K., & Bogner, F. X. (2014). The effects of children's age and sex on acquiring pro-environmental attitudes through environmental education. *The Journal of Environmental Education, 45*(2), 105–117.

Lienert, G. A., & Raats, U. (1994). *Testaufbau und Testanalyse*. Weinheim, Berlin, Basel: Julius Beltz.

Lindemann-Matthies, P. (2002). The Influence of an Educational Program on Children's Perception of Biodiversity. *The Journal of Environmental Education, 33*(2), 22–31.

Lindemann-Matthies, P. (2005). ‘Loveable’ mammals and ‘lifeless’ plants: how children's interest in common local organisms can be enhanced through observation of nature. *International Journal of Science Education, 27*(6), 655–677.

Mayring, P. (2004). Qualitative content analysis. In: U. Flick, E. von Kardorff & I. Steinke (Hrsg.), *A companion to qualiative research* (S. 266–269). London: SAGE Publications.

Milfont, T. L., & Duckitt, J. (2004). The structure of environmental attitudes: A first- and second-order confirmatory factor analysis. *Journal of Environmental Psychology, 24*(3), 289–303.

Miller, J. R. (2005). Biodiversity conservation and the extinction of experience. *Trends in Ecology and Evolution, 20*(8), 430–434.

Munoz, F., Bogner, F. X., Clement, P., & Carvalho, G. S. (2009). Teachers' conceptions of nature and environment in 16 countries. *Journal of Environmental Psychology, 29*(4), 407–413.

Pekrun, R. (1992). The Impact of Emotions on Learning and Achievement: Towards a Theory of Cognitive/Motivational Mediators. *Applied Psychology, 41*(4), 359–376.

Randler, C. (2004). *Kognitive und emotionale Faktoren des Lernens: Am Beispiel einer Biologieunterrichtseinheit „Lebensraum See“*. Hamburg: Kovac.

Randler, C., Hummel, E., Gläser-Zikuda, M., Vollmer, C., Bogner, F. X., & Mayring, P. (2011). Reliability and validation of a short scale to measure situational emotions in science education. *International Journal of Environmental & Science Education, 6*(4), 359–370.

Schneller, A. J., Johnson, B., & Bogner, F. X. (2013). Measuring children’s environmental attitudes and values in northwest Mexico: validating a modified version of measures to test the Model of Ecological Values (2-MEV). *Environmental Education Research*, *21*(1), 61-75.

Sebba, R. (1991). The Landscapes of Childhood: The Reflection of Childhood's Environment in Adult Memories and in Children's Attitudes. *Environment and Behavior, 23*(4), 395–422.

Sellmann, D., & Bogner, F. X. (2013). Climate change education: quantitatively assessing the impact of a botanical garden as an informal learning environment. *Environmental Education Research, 19*(4), 415–429.

Slavin, R. E. (1980). Cooperative Learning. *Review of Educational Research, 50*(2), 315–342.

Unesco (2005). *UN Decade of Education for Sustainable Development, 2005-2014: The DESD at a glance*. Paris: UNESCO.

United Nations (1992). *Agenda 21. Programme of action for sustainable development. Rio declaration on environment and development*. New York: United Nations Department of Public Information.

Wells, N. M. (2000). At Home with Nature: Effects of "Greenness" on Children's Cognitive Functioning. *Environment and Behavior, 32*(6), 775–795.

Wilcox, R. R. (2012). *Introduction to Robust Estimation and Hypothesis Testing*. Amsterdam: Elsevier/Academic Press.

Zimen, E. (2003). *Der Wolf - Verhalten, Ökologie und Mythos*. Stuttgart: Kosmos.

5 Teilarbeiten

5.2 Publikationsliste

Die aus der vorliegenden Arbeit hervorgegangenen Publikationsmanuskripte sind im Folgenden aufgeführt.

A. Dieser, O. and Bogner, F. X. (2015). *Young peoples' cognitive achievement as fostered by a hands-on-centred environmental education.*
Environmental Education Research (in press).
DOI: 10.1080/13504622.2015.1054265

B. Dieser, O. and Bogner, F. X. (2015). *How does hands-on outdoor learning influence children's environmental perception?*
Journal of Environmental Education (submitted)

C. Dieser, O. and Bogner, F. X. (2015). *Intervention impact on young students' associations about wolf and lynx.*
Society and Animals (submitted)

5.2 Darstellung des Eigenanteils

Das für alle drei Teilstudien verwendete Unterrichtsprogramm wurde in Zusammenarbeit mit der Leiterin des Jugendwaldheims im Nationalpark Bayerischer Wald entwickelt und angepasst. Dafür wurden Unterrichtselemente unter Verwendung bestehender Quellen zu einer Einheit verschmolzen. Die Durchführung des Programms erfolgte größtenteils durch mich sowie durch speziell ausgebildete Waldführer des Nationalparks Bayerischer Wald. Alle Evaluationsinstrumente wurden aus der Literatur übernommen bzw. von mir angepasst. Alle Teilstudien wurden unter der Betreuung meines Doktorvaters von mir konzipiert und verfasst.

5.3 Teilarbeit A

Dieser, O. and Bogner, F. X. (2015)

Young peoples' cognitive achievement as fostered by a hands-on-centred environmental education

Environmental Education Research

(in press; DOI: 10.1080/13504622.2015.1054265)

Environmental Education Research, 2015
http://dx.doi.org/10.1080/13504622.2015.1054265

Young people's cognitive achievement as fostered by hands-on-centred environmental education

Olivia Dieser* and Franz X. Bogner

Department of Biology Education, Centre of Math & Science Education (Z-MNU), University of Bayreuth, Bayreuth, Germany

(Received 5 August 2014; accepted 7 April 2015)

In line with previous studies, where outdoor nature experience was shown to support adolescents' environmental knowledge, our study within a National Park monitored the influence of a hands-on centred environmental programme on cognitive knowledge achievement. A sample of 4th and 5th graders (n = 289) completed a week-long conservation programme with two follow-up options: The first group (n = 170) interacted with thematic posters, the second group (n = 128) additionally completed a thematic board game. In a quasi-experimental design, we analysed both versions with regard to achievement efforts and individual situational emotions. Altogether, programme participation added cognitive knowledge, group one (poster and board game as follow-up option) outmatched group two (just the poster option). State emotion measured regarding the programme and right after game participation revealed positive effects toward knowledge. Thus, direct experiences with nature and additional hands-on followup activities may foster a student's cognitive achievement.

Keywords: outreach ecology education; cognitive knowledge; situational emotions; biodiversity efforts; follow-up activities; primary school students

Introduction

Outdoor education has been introduced to the school curriculum and has been successfully implemented in the last century in order to increase the students' connection to nature and to influence their learning persistently by directly discovering, observing and interpreting the natural setting (Hammerman 1980). Especially through programmes of action for sustainable development in the early 90's, such outdoor education programmes became even more important for schools to implement (United Nations 1992). Several institutions like field centres or museums, zoos or national parks offered programmes with environmental issues regarding their specific field. Likewise, schools began related projects like school gardening or the green classroom as well as initiated cooperation projects with outreach facilities (Drissner, Haase, and Hille 2010; Fančovičová and Prokop 2011). Additionally, summer camps offering environmental education for children in holidays or specific programmes like Earth Education were developed (Van Matre 1990; Dresner and Gill 1994). With the intention of such programmes to improve the environmental knowledge as well as attitudes or even behaviour skills, some measures point to a positive change at least (e.g. Leeming et al. 1993; Dillon et al. 2006). However, in a meta-analysis, Zelezny (1999) analysed the effectiveness of outdoor education with classroom interventions and interpreted higher pro-environmental behaviour after classroom interventions compared to non-traditional informal settings. More precisely, such differences in literature highlight the dilemma that numerous factors may influence changes in environmental achievement, awareness and behaviour as well as the difficulty of measuring them in a empirically valid manner (Morag and Tal 2012). For instance,

some authors reported an improvement of environmental knowledge without reaching pro-environmental attitudes and behaviours, while attitude or behaviour levels were more likely to intervene with long-term and direct programmes (e.g. Bogner 1998; Duerden and Witt 2010). Additionally, variables like age, prior knowledge and experiences or the novelty of a setting are often cited as being influential to improve environmental knowledge, attitudes and behavior (Dillon et al. 2006).

Nevertheless, out-of-school learning environments such as museums, planetariums, aquariums, science centres and especially field trips were shown to have significant influences on the students' cognitive, affective, social and behavioural achievement (reviewed in Morag and Tal 2012). Additionally, field trips are provided with hands-on and direct experiences of the real nature enhancing students' interest, motivation and other aspects of learning (Rickinson et al. 2004; Dillon et al. 2006). Since direct experiences with natural settings also seem to play crucial roles to achieve higher levels of conservation awareness (Bogner 1999; Dettmann-Easler and Pease 1999; Bogner and Wiseman 2004), we used the National Park to implement an outdoor education intervention. National parks frequently offer outreach programmes including specific week-programmes for schools. Apart from the educational purpose, these parks first of all are sites to protect unique nature untouched by humans. Its pristine nature provides a setting to become acquaint with original regional nature and to understand important biological processes such as succession. Coming into close contact with nature and learn about regional environments is regarded essential to children of whom many are unable to identify indigenous tree species and other plants of the forest (Lindemann-Matthies 2002; Tal, Lavie Alon, and Morag 2014). In order to observe regional animals in natural environments, large animal enclosures are provided in the National park 'Bavarian Forest', which in contrast to zoos are much larger and the animals are kept in their natural environment within protected conservation zones. Therefore, another focus was laid on the biology and natural history of two carnivores (lynx and wolf). We decided for these two animals because they have been re-establishing in Germany for almost 20 years. Despite some projects supporting a successful co-existence with humans, still many prejudices against these animals exist. In the eighteenth and nineteenth centuries, both were eradicated due to human population increases and competition with humans' livestock as well as with preferred game species. Especially wolves were reflected upon negatively as beasts, parasites or even devils (Breitenmoser 1998; Lynn 2010). Although, lynx were never considered as dangerous for human beings, they were described as ferocious, cunning and courageous (Breitenmoser 1998). Nowadays, these animals are back in region but still are endangered and thus protected. However, within rural regions these animals are still regarded as threats (Breitenmoser 1998; Stöhr and Coimbra 2013). To counteract these prejudices and to reach a better understanding, students need to learn more about these animals, for instance, by observing them.

A playful and open structure with many hands-on activities may support the specific outdoor situation different to school structures and secondly, may evoke learning emotions, which may influence the cognitive achievement. Several studies pointed to the importance of affect-cognition linkages, in educational experiences (e.g. Mayring and Rhöneck 2003; Värlander 2008). However, the focus of these studies laid on classroom situations and focused on negative learning emotions like test anxiety or exam pressure (Pekrun 1992; Gläser-Zikuda et al. 2005). Very little is known about the influence of positive learning emotions on cognitive achievement (Gläser-Zikuda et al. 2005; Derakshan and Eysenck 2010). In contrast to classroom interventions, our present study aimed to evoke positive emotions by implementing hands-on and affective approaches in an outdoor setting. Allen (2010), for instance, demonstrated most cognitive gains after experiencing intense emotions during an

educational intervention. Since such emotions are regarded situation-specific, we concentrated on state and not on trait emotions, which in contrast are mainly biographically generated (Ainley 2006; Randler et al. 2011). These situational learning emotions are differentiated in Well-Being (subjective positive feeling during the lesson), Interest (cognitive orientation) and Boredom (lack of action and interest; for detailed information see Randler et al. 2011). However, they have never been analysed in a hands-on structured outdoor programme.

Learning processes depend on many preconditions such as, for instance, precognition, social situation or learner's interest as well as the kind of participation, motivation or preparatory phases. Preparatory phases including detailed instructions of follow-up outdoor programmes indicated significantly higher increases in environmental knowledge, but also in attitudes and behaviour (Duerden and Witt 2010). Likewise, many studies examining the influence of outdoor education approaches on knowledge acquisition suggest a follow-up, within-class reinforcements as best option to consolidate environmental concepts and awareness (Dettmann-Easler and Pease 1999). Farmer and Wott (1995) described follow-up activities after field trips as influential, increasing knowledge scores compared to a placebo group. Consequently, the objectives of our study were twofold: (i) First, we also embedded a follow-up phase during and at the end of the intervention. Again, to avoid typical school follow-up activities like written or oral repetitions, our study orientated on hands-on and very open learning structures of the whole intervention. Two follow-up variations detached from typical paper-pencil tasks or memorising facts – graphical summary and game participation -, were applied to repeat the most important information covered during the outdoor intervention. (ii) Second, we focussed on the kind of influence of open-structured environmental intervention on cognitive achievement. Throughout the study, we asked the following question: Do the two different follow-up activities enhance the cognitive achievement and if so, do they influence the knowledge gain in different ways?

Methods

Participants and procedure

Our education programme was completed by 298 students of 4th and 5th graders (52.3% girls, mean age = 10.03 ± .87) from regional schools around the National Park 'Bavarian Forest' from January to July 2013. In order to exclude cognitive achievement by the mere answering of our questionnaires, a 'test-retest' group of 60 students (without any intervention) with similar backgrounds served as control (41.8% girls; mean age = 9.97 ± .84). The teachers and parents assented to our project after they had assigned to a residential visit to the park's field centre.

In a quasi-experimental design, cognitive achievement and situational emotions were measured by using paper-pencil-questionnaires consisting of 15 ad hoc knowledge and 9 situational emotion items. The knowledge questionnaire consisted of a multiple-choice test, with four possible options, but only one correct answer (Table 1). An expert rating of biology educators assured the questionnaire's validity.

In contrast, the situational emotions of Well-Being, Interest and Boredom were monitored with a three items subscale each by following a 5-point Likert response pattern, ranging from 'strongly agree' to 'strongly disagree' (for details and item wording, see Randler et al. 2011). For monitoring the short- and long-term cognitive outcome, a pre-, post- and retention test design was applied. Up to two weeks before participation, the first questionnaire (T0) was completed at school. All teachers were instructed to avoid any preparation or discussion about the programme content with the students before

participation. At the programme's end, the post-test (T1) was completed on site. Four to six weeks later, the retention test (T2) was completed at school (Figure 1). At each measurement point, the same item set was chosen, but arranged randomly. The situational Emotions were measured only at T1 and additionally right after the students played the board game. The knowledge post-test reliability of Cronbach's α was .51, which is sufficient for ad hoc questionnaires to compare groups (Lienert and Raats 1994). Cronbach's α of the situational emotions scored .56 for Boredom, .78 for Interest and .79 for Well-Being.

Table 1. Item examples of the knowledge questionnaire.

Sample item	Response possibilities
How can humans implement the motto: "Let nature remain nature"?	a) They monitor the forest. **b) They do not intervene with nature.** c) They help the forest to grow. d) They remove dead trees from the forest.
What is a squirrel doing in autumn?	**a) collecting and hiding food storage** b) building a nest for the winter c) searching for a cave for the dormancy d) building a cave in the ground
What is a young lynx doing after leaving his mother?	a) searching a partner b) wandering with his siblings **c) searching a new territory** d) looking for friends
How could a lynx territory be extended?	a) create fields between forest areas **b) create connections between forests** c) built rock caves d) offer more hiding places

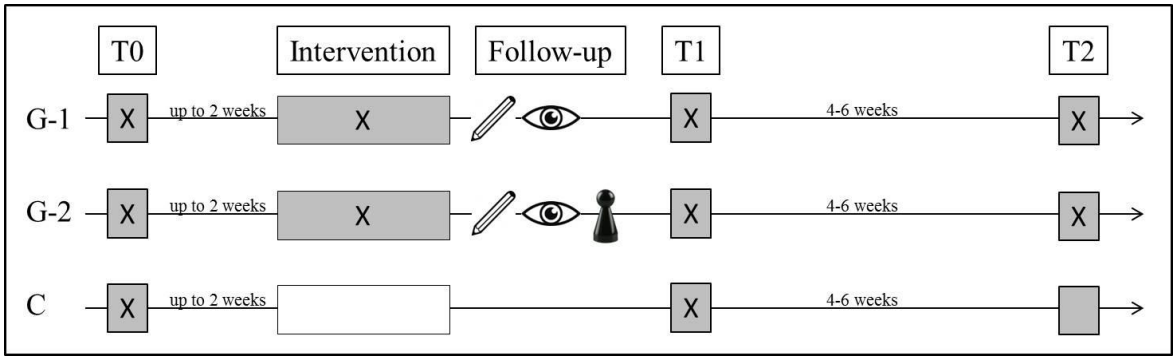


Figure 1. Study design with time frame of evaluation (T0, T1, T2) for the two intervention groups (G-1, G-2) and the control group (C).
Note: X: participation, pen: personal booklet (daily available), eye: poster (daily available), token: game (last day available).

Environmental education programme

The residential week-long programme was undertaken in the National Park 'Bavarian Forest' with the intent to foster a student's individual connection to local nature and to support individual enjoyment by spending time outside. The thematic focus was the park's characteristic forest ecology as well as species conservation.
Wolf and lynx were emphasised as reintroduced species by highlighting the biology of these animals and natural history aspects in the view of existing prejudices. Groups of 7–12 students were guided by experienced outdoor educators. All instruction was based on original encounter, hands-on and affective-based approaches such as outdoor simulation role plays (e.g. 'storage strategies of squirrel', 'mapping of noises', 'lynx and deer interrelation').
On the first day, via randomly assigned animal names, small groups of up to 12 students were formed subsequently led by a qualified outdoor educator. In the follow up, students were playfully discovering the immediate surroundings by identifying characteristics of tree species (e.g. 'Touch a tree'), learning about domestic animal species (e.g. 'Identify animals') or discovering tree tops (e.g. 'Mirror walk'). In an adventure activity, forests, meadows or wetlands (depending on the season) were the topic of interaction: Within the teams, ecological tasks were discovered (e.g. functions of a National Park, storage strategies of squirrels). A forest playground area additionally supported the individual emotional approach, for instance, by detecting animal tracks or barefoot feeling of different soils. During a half-day hike in a 'dead' mountain forest area, the relationship of bark beetle infestation, spruces and weather conditions was highlighted. While hiking through the 'dead' forest section, succession potential towards a new 'wild' forest was discussed. Additionally, potential reasons for the bark beetle destruction were reviewed (for more detail see Table 2).
All original impressions were refreshed within a visitor centre with interactive information materials based mainly on hands-on experience. Finally, the Animal Ground with its large enclosures allowed observation of wolf and lynx. During this activity, life circles and population distributions were the issue of instruction. In front of the wolf and lynx enclosure, initial observation tasks were given followed by a learning approach about typical behaviour patterns. Afterwards, in a simulation role game the students imitated the family life of the wolf and the hunting techniques of the lynx. Finally, an artificial tree top path was used in order to deepen individual knowledge about trees and the forest in general (Table 2).
All students had received a personal booklet which served as a diary during the complete stay in the National Park. It contained guidelines to paint, to locate animals to match within a forest picture as well as templates to collect leaves and other preselected items. Every evening, students were urged by their teachers to summarize their experiences of that day into their booklets. To remember all the activities over the day and to enrich the individual diary entries, three thematic posters were available daily. The analysis of the diaries, however, was not in the focus of this study. The learning process was further supported by different follow-up activities: Intervention group one (G-1, n1 = 170) interacted only with three thematic posters, elucidating the most important content of the programme, the wolf, the lynx and the forest itself. Intervention group two (G-2, n2 = 128) had also the possibility to interact with the posters. In addition to the posters, a board game was completed on the last day. This game accomplished in small groups followed a competitive mode (which was supposed to introduce an additional emotional effect).

Table 2. Description of the programme content regarding the issues forest, wolf and lynx.

Forest	Rediscover trees	One blindfolded student, guided by another student needs to remember a tree by touching the bark of a tree and afterward recognising it without blindfold. Both students have to discover which kind of tree species they found and have to look out for this kind of species in the forest.
	Tree top path	Information boards shown over the complete path allow specifying the differences between firs, spruces and beeches. High trees, up to 25m, illustrated how trees withstand winds.
	Forest Playground	Visiting a forest area with its different exploration stations. Each station offered different forest related topics to experience: E.g., walking along a barefoot path or identifying animal tracks.
	Simulation game: Survival strategy of squirrels	By imitating hiding behaviours of squirrels students need to re-find storage sites.
Wolf	Observing wolves	In the animal ground with its large enclosures wolves were observed. Attention was paid to typical behaviours as well as to potential abnormalities.
	Learning about the wolf	Posters were presented with different issues such as annual cycles, body variables and distribution patterns in Europe.
	Simulation game: Wolf family	A role of a wolf within the wolf family was imitated, e.g. being a parent or hunting and caring for cubs. Students learn about the different tasks by playing together as a family.
Lynx	Observing lynxes	In the enclosure, Lynx have to be located (when hiding) and observed; as well as the biotope structures important to lynx had to be discussed.
	Learning about the lynx	Posters with different topics such as the annual cycle, body variables and distribution patterns in Germany were discussed.
	Simulation game: Chasing lynx	Hunting behaviour was simulated between lynx and roe deer: A blindfolded lynx had to “hunt” a roe deer by recognising the deer’s walking noises.

Statistical analysis

To analyse the quality of our knowledge scale, we used the simple Rasch-model for dichotomous items. This probabilistic model describes probabilities for correct answers as a function of person ability and item difficulty (Bond and Fox 2007). All calibrations of the Rasch model were assessed by means of the QUEST programme (Adams and Khoo 1996). The knowledge outcome analysis was carried out in R (R Development Core Team 2013) and further calculated with IBM SPSS Statistics 21. For every student a total knowledge

score was calculated for each test time. Given answers were scored correct (1 point) or incorrect (0 points); maximum score was 15, minimum score 0. Due to the central limit theorem, the data of the experimental group were assumed as normally distributed and analysed with parametric tests (Wilcox 2012). For knowledge differences, we fitted linear mixed models using the function 'lmer' from R package lme4. We selected the school as random effect to account for possible differences among schools and the student identity to account for repeated measurements (Bolker et al. 2009). The post hoc test with multiple adjusted p-values was calculated by using the function glht in R package multcomp (Hothorn, Bretz, and Westfall 2008). Data of the control group were not distributed normally. Therefore, comparisons between the experimental and 'test-retest' group were calculated with the non-parametric Wilcoxon and Mann-Withney-U-Test. Influences of the state emotions after the intervention and right after the students had played the board game on the cognitive achievement were calculated with the Spearman's Rho correlation coefficient.

Results

Our ad hoc knowledge questionnaire first was Rasch-analysed by producing a Wright map (Item-Person map) detailing the individual person's performance indicated by an X shown as a function of item difficulty (Bond and Fox 2007). The logit scale (on the left hand of Figure 2) indicates the measurement unit common for both the person performance and item difficulty. Items with logit values above the threshold of .0 are assumed to be more difficult to answer than items below, and correspondingly persons located in the upper half are assumed as being more able to answer an item than persons in the lower half. Figure 2 displays the Wright map connecting each individual item with a number. Consequently, most students are shown with an ability estimate of .83 logit, which means probabilities to answer correctly are estimated higher than persons with lower ability estimates. Additionally, persons with an ability estimate of .50 logit will have a higher chance to correctly answer items located below a .50 logit threshold than the ones located above this threshold. Consequently, our item selection is shown as slightly too easy, since most of the students' ability estimate is scoring over a .0 logit threshold, whereas most items are located below the .0 difficulty threshold.

Fit statistics for person abilities and item difficulties, shown in Table 3, are reported as mean squares in the form of chi-square statistics divided by the degrees of freedom and normalized t distribution. The data match the model as expected values with mean squares for items and persons about one and standard deviation about zero (Bond and Fox 2007). Fit statistics of t-values also conform to the model with the observed data about zero and standard deviation about one.

As expected, no significant knowledge gain occurred within the 'test-retest' group over time ($Z = -1.03$, $p > .05$). In contrast, the overall knowledge increase of both intervention groups was significant for short- (T1– T0; ANOVA, $F(1, 332) = 149.29$, $p < .001$) and long-term (T2–T0; $F(1, 332) = 93.15$, $p < .001$). Dividing all items thematically into subgroups, which is forest (ANOVA, $F(1.99, 581.84) = 46.98$, $p < .001$), wolf ($F(2, 594) = 11.14$, $p < .001$) and lynx ($F(1.94, 575.04) = 37.45$, $p < .001$), a significant increase for all issues short- and long-term were also found. When analysing the two intervention groups separately (without the thematic subgroups), both provided a significant knowledge increase in the short-term and the long-term as well (Figure 3 and Table 4).

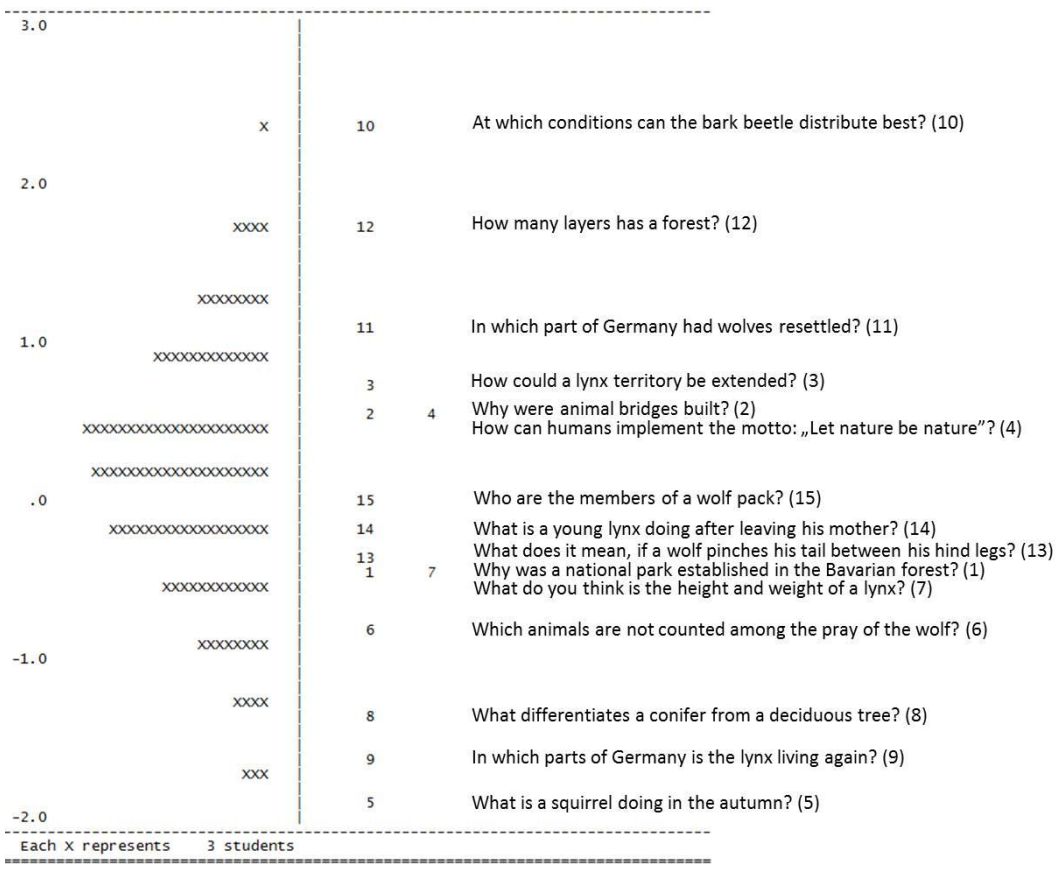


Figure 2. Wright map (Item-Person map) of the simple Rasch model analysis. The logit scale (left hand) indicates the measurement unit for the individual person performance (X) and the item difficulty (number + item).

Table 3. Fit statistics for person abilities and item difficulties.

	Infit mean square	Outfit mean square	Infit *t*-statistic	Outfit *t*-statistic
Item fit (*M*)	1.00	1.02	-.04	.12
Item fit (*SD*)	.05	.15	.92	.86
Person fit (*M*)	1.00	1.02	-.01	.09
Person fit (*SD*)	.27	.56	.96	.81

Note: Abbreviations found in the fit statistics: Mean (M), Standard deviation (SD).

Subsequently, the learning outcome between the two different intervention groups was calculated in more detail: To compare intervention group one (G-1: intervention including poster interaction, n1 = 170) directly with group two (G-2: intervention including poster interaction and game participation, n2 = 128) no differentiation of the two groups at T0 had to be considered. Taking this rule into account, at T1 and T2, G-2 learned significantly more ($p \leq .001$).

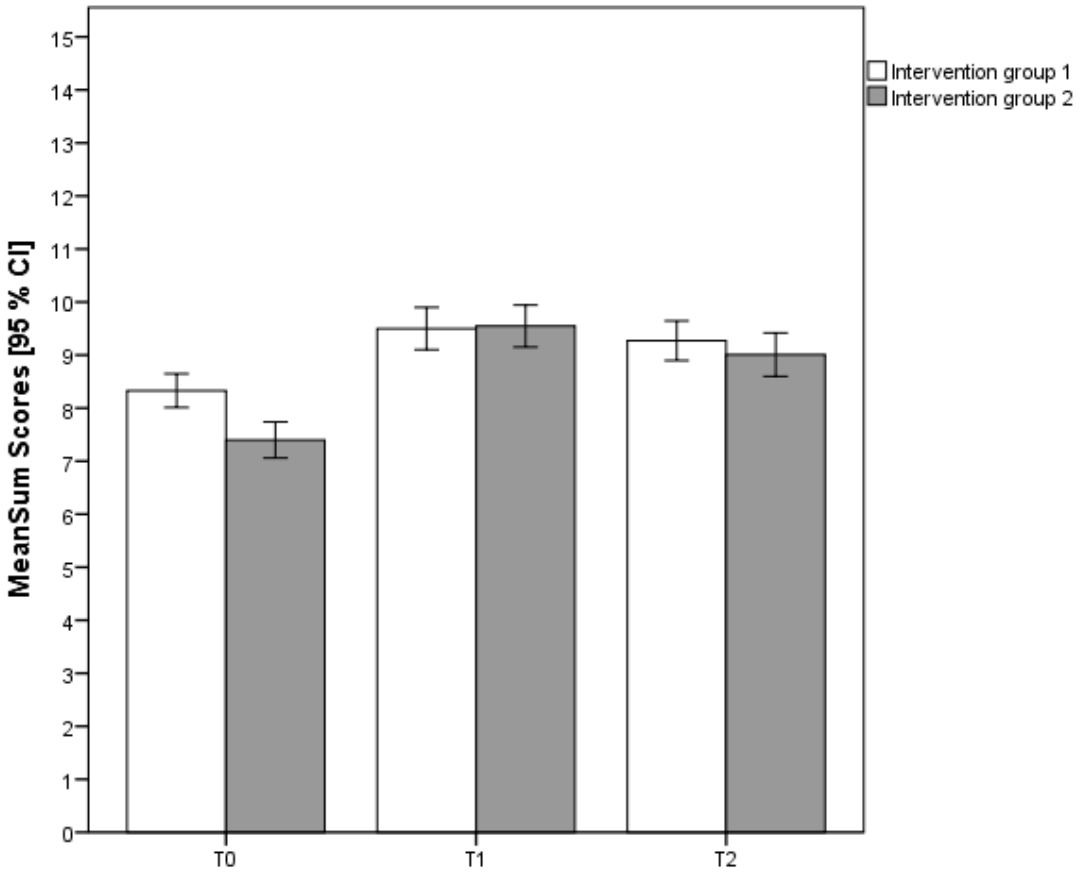


Figure 3. Knowledge increase of overall mean test scores of the two intervention groups in time and per treatment.
Note: Bars are 95% confidence interval (CI).

Table 4. Short- and long-term knowledge increase of the two intervention groups.

	short-term (T0-T1)				long-term (T0-T2)			
	Δ	*F*	*p*	*r*	Δ	*F*	*p*	*r*
G-1 (poster)	1.28	50.77	<.001	.48	.94	28.55	<.001	.38
G-2 (poster& game)	2.15	103.04	<.001	.67	1.61	62.06	<.001	.57

When comparing the effect of gender within the intervention groups (nm = 142, nf = 156), a similar short- and long-term knowledge increase appeared (short-term: T (296) = .07, p > .05, r = .004; long-term: T(274.22) = .267 p > .05, r = .016).
Situational emotions developed during the project participation on students' knowledge achievement produced just very small, but significant effects of Well-Being and Interest on long-term knowledge, while Well-Being affected short-term knowledge (see Table 5). Significant correlations between situational emotions developed during the board game and knowledge increase were only found for Well-being on short-term knowledge (Table 5). These effects remained significant after Bonferroni correction.

Table 5. Correlation between knowledge increase and state emotions (a) during projectparticipation (b) or during game participation (1-tailed).

knowledge increase			*State-Boredom*	*State-Interest*	*State-Well-Being*
short-term	a) project participation	*r*	-.104	.058	.142
		p	ns	ns	.005
	b) game participation	*r*	-.119	.117	.171
		p	ns	ns	.001
long-term	a) project participation	*r*	-.130	.141	.160
		p	ns	.005	.002
	b) game participation	*r*	-.099	.118	.129
		p	ns	ns	.009

Note: N = 333, after Bonferroni correction $p \leq .005$ indicates significant effects.

Discussion

Our outreach educational programme produced a significant knowledge increase immediately after the intervention, which also persisted over a period of six weeks. These results are in line with previous studies aiming to attract children and adolescents towards nature and biodiversity (e.g. Falk and Balling 1982; Bogner 1998; Wells 2000; Duerden and Witt 2010). Lindemann-Matthies (2002), for instance, considered outreach programmes as essential to counteract the existing knowledge gap about forest ecosystems and its biodiversity. Further, she pointed to the importance of such programmes in central Europe, where children often are unable to identify indigenous tree species and other plants of the forest. Thus, our present study was able to clearly show an increase in knowledge regarding the forest, by providing a significantly knowledge gain. More precisely, the thematically knowledge gain regarding wolf and lynx was promising. These results confirmed our expectations that such a programme with many affective strategies and hands-on activities changes the students' prejudices of the animals towards factual knowledge. Understanding the natural history of wolves and lynx as well as its potential relationship with human beings may decrease or even eliminate critical encounters (Hermann and Menzel 2013). Additionally, observing the animals in natural enclosure environments in connection with simulation role games pointing to real life situations, the animals' natural characteristics and behaviour became more vivid. Consequently, students were urged to brainstorm about animal conservation in the hope for leading to some personal action.

The entire knowledge gain showed small but essential increase over time. Analysing the Wright map of the pre-test, it becomes evident that our knowledge items selection might have been too easy to answer: Students reached highest levels ranging about eight of fifteen scores. Therefore, high pre-knowledge very likely made it difficult to maximise scores compared to a start from a small pre-knowledge (Bond and Fox 2007). A potential follow-up study needs to take this into consideration.

Well-structured education programmes have previously demonstrated cognitive learning potential (Bogner 1999, 2002; Bogner and Wiseman 2004). They are constructed with a common theme, which is consistently repeated within several contexts and structured in

that way that students enthusiastically follow the programme content. Independently of research backgrounds, well-structured programmes had shown to positively influence students' knowledge achievement (Falk and Balling 1982; Bogner 1998; Prokop, Tuncer, and Kvasničák 2007; Duerden and Witt 2010; Liefländer et al. 2015). For instance, both short- and long-term programme options with direct encounters produced knowledge gains (Duerden and Witt 2010). Therefore, our described significant knowledge increase might originate from the inclusion of many hands-on experiences and well-structured sequences. Additionally, the direct experience with the National Parks' nature may have also an influence on the students' development of self-esteem, curiosity and interest for the issues (Dresner and Gill 1994).

Falk (1983) indicated, besides other factors, novelty as a crucial role for any learning in outreach environments: The more familiar students are with new environments, the more they are able to learn and to retain. This matter especially counts for younger children (aged 8 to 9), whereas older students (aged 10 to 11) learned best outdoor in a novel environment. Falk (1983) therefore preferred repeated visits to unfamiliar environments, in order to maintain the best learning scores. Our study site was an unknown environment for almost all students. Although forests and some wild animals are familiar to students, a National Park forest environment is quite unusual in a heavily overpopulated country such as Germany. Therefore, a first exploration phase in our programme served to familiarise students with the new environment. Social games embedded into those field trips may support a feeling of being familiar with such novel environment, too. When feeling more comfortable and familiar in a specific environment, students are expected to easily concentrate on additional new settings (Orion and Hofstein 1994). This fact may also have influenced our knowledge increase finding.

Knowledge achievement during outdoor environmental education is also dependent on variables such as preparation phases and/or follow-up activities of the programme: Many previous studies have reported higher knowledge increase due to pre-programme activities (Anderson, Kisiel, and Storksdieck 2006). Dettmann-Easler and Pease (1999) highlighted the potential of combining outdoor activities and thematic repetition at school classrooms as a follow-up activity. Although such repetitions may exist at the end of lessons or as homework, few studies focussed on consolidation phases and follow-up activities in school (Farmer and Wott 1995; Muhlenbruck et al. 2000; Gerstner and Bogner 2010). Most repetition forms are generated as paper-and-pencil tasks, reading books or memorising facts from school lessons. According to our programme content, the follow-up activities were planned as being detached from typical consolidation forms. However, these activities should not serve as an extension of the programme content; it was much more a content repetition of the week. The offer of the two different activities, being based on a combination of graphical summary and game participation, produced a significant higher knowledge increase. This combination apparently enhanced the knowledge level through the twofold repetition of the programme content and the intergroup competition, which was reported as turning out to be very effective (Johnson et al. 1981). Cooperation within subgroups may give a player a feeling of higher knowledge levels compared to a single participant (Slavin 1983; Johnson and Johnson 1991). Consequently, the intergroup competition may encourage students to work together and to have fun instead of creating a serious character of the game, which often results in negative achievement (Slavin 1980; Johnson and Johnson 1991). Our monitoring results of state emotions, measured immediately after the game completion, showed Well-Being correlated with short-term knowledge increases. Thus, the positive emotion (Well-Being) might be developed through the motivational and cooperative procedure of the group members affecting the individuals' knowledge achievement positively (Slavin 1996). Knowledge evoked by

group members during the play may therefore be remembered in the post-test better through the emotional link.
In addition, the situational emotions regarding the whole intervention were measured at the end of the project and compared with the knowledge gain. Only Well-being could significantly influence the knowledge achievement directly after the intervention. However, Well-being and interest had significant influence on long-term knowledge gain, too. These results confirm that subjective positive feelings like Well-Being during the intervention work as a moderating variable regarding learning success (Randler et al. 2011). The interest as the more cognitive orientation caused by the intervention influenced the students' learning process additionally after the intervention and thus showed a cognitive long-term effect. Consequently, environmental programmes constructed relatively open with many hands-on approaches and affective activities evoke positive feelings, which finally results in higher learning potentials and needs consideration in future programmes (Fröhlich, Sellmann, and Bogner 2013).
In conclusion, outdoor environmental education programmes, structurally detached from typical school lessons and in line with appropriate hands-on activities, apparently produce a subsequent knowledge achievement. Both follow-up activities, interacting with a poster or completing a board game, support knowledge gain. Although we cannot distinguish between affective or collective feelings induced by playing the game when analysing our knowledge increase, such facets highlight the importance of more open activities within cognitive outreach learning. Participation in our programme helped gaining knowledge through open hands-on exercises and affective follow-up activities. Although deeper knowledge about such correlations is needed, we recommend the triggering of knowledge achievement by using affective structures especially with young students.
However, it still remains open, whether the length of the intervention, the structure of the programme or some more factors are influential. Several studies showed that similar or the same lessons in classroom also resulted in cognitive achievement (Duerden and Witt 2010).Yet, very often such programmes were only increasing knowledge but did not show any effect on environmental attitudes or behaviour. In contrast, it were exactly these hands-on approaches that revealed several times a positive influence on cognitive achievement and additionally on attitudes and behavior (e.g. Bogner 1998, 1999). Nevertheless, attitudinal influences caused by the current intervention will be published elsewhere.

Acknowledgements

This article has been published in the Journal *Environmental Education Research*, 2015, and is available online: http://dx.doi.org/10.1080/13504622.2015.1054265.

The authors like to thank the National Park 'Bavarian Forest' in particular, the 'Jugendwaldheim, Wessley Haus' with R. Gaidies and her team for supporting and implementing the educational programme. Furthermore, we gratefully acknowledge statistical advice by R. Hable and M. Wiseman; the latter additionally we thank for valued comments on earlier drafts of our manuscript. Last but not least, we thank all students, teachers and volunteers involved in this study for cooperation.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Olivia Dieser is a PhD student at the Centre of Math & Science Education, Department of Biology Education, University of Bayreuth, Germany. Her research focuses on promoting young students' knowledge and environmental perceptions through environmental outdoor education.

Franz X. Bogner is a full professor, director of the Centre of Math & Science Education, Department of Biology Education, University of Bayreuth, Germany. His main research focuses on educational interventions' design by specifically taking into account the attitudinal, behavioural and cognitive effects due to participation. Together with M. Wiseman, he has developed the attitudinal 2-MEV scale which up to now was thrice independently confirmed and is currently used in 21 languages of the world.

References

Adams, R. J., and S. T. Khoo. 1996. *Acer Quest*. Camperwell: Acer Press.

Ainley, M. 2006. "Connecting with Learning: Motivation, Affect and Cognition in Interest Processes." *Educational Psychology Review* 18 (4): 391–405.

Allen, M. 2010. "Learner Error, Affectual Stimulation, and Conceptual Change." *Journal of Research in Science Teaching* 47 (2): 151–173.

Anderson, D., J. Kisiel, and M. Storksdieck. 2006. "Understanding Teachers' Perspectives on Field Trips: Discovering Common Ground in Three Countries." *Curator: The Museum Journal* 49 (3): 365–386.

Bogner, F. X. 1998. "Environmental Perceptions of Irish and Bavarian Pupils: An Empirical Study." *The Environmentalist* 18: 27–38.

Bogner, F. X. 1999. "Empirical Evaluation of an Educational Conservation Programme Introduced in Swiss Secondary Schools." *International Journal of Science Education* 21 (11): 1169–1185.

Bogner, F. X. 2002. "The Influence of a Residential Outdoor Education Programme to Pupil's Environmental Perception." *European Journal of Psychology of Education* 17 (1): 19–34.

Bogner, F. X., and M. Wiseman. 2004. "Outdoor Ecology Education and Pupils' Environmental Perception in Preservation and Utilization." *Science Education International* 15 (1): 27–48.

Bolker, B. M., M. E. Brooks, C. J. Clark, S. W. Geange, J. R. Poulsen, M. H. H. Stevens, and J.-S. S. White. 2009. "Generalized Linear Mixed Models: A Practical Guide for Ecology and Evolution." *Trends in Ecology & Evolution* 24 (3): 127–135.

Bond, T. G., and C. M. Fox. 2007. *Applying the Rasch Model*. New York: Taylor & Francis Group.

Breitenmoser, U. 1998. "Large Predators in the Alps: The Fall and Rise of Man's Competitors." *Biological Conservation* 83 (3): 279–289.

Derakshan, N., and M. W. Eysenck. 2010. "Introduction to the Special Issue: Emotional States, Attention, and Working Memory." *Cognition and Emotion* 24 (2): 189–199.

Dettmann-Easler, D., and J. L. Pease. 1999. "Evaluating the Effectiveness of Residential Environmental Education Programs in Fostering Positive Attitudes toward Wildlife." *The Journal of Environmental Education* 31 (1): 33–39.

Dillon, J., M. Rickinson, K. Teamey, M. Morris, M. Y. Choi, D. Sanders, and P. Benefield. 2006. "The Value of Outdoor Learning: Evidence from Research in the UK and Elsewhere." *School Science Review* 87 (320): 107–112.

Dresner, M., and M. Gill. 1994. "Environmental Education at Summer Nature Camp." *The Journal of Environmental Education* 25 (3): 35–41.

Drissner, J., H.-M. Haase, and K. Hille. 2010. "Short-Term Environmental Education – Does It Work? – An Evaluation of the 'Green Classroom'." *Journal of Biological Education* 44 (4): 149–155.

Duerden, M. D., and P. A. Witt. 2010. "The Impact of Direct and Indirect Experiences on the Development of Environmental Knowledge, Attitudes, and Behavior." *Journal of Environmental Psychology* 30 (4): 379–392.

Falk, J. H. 1983. “Field Trips: A Look at Environmental Effects on Learning.” *Journal of Biological Education* 17 (2): 137–142.

Falk, J. H., and J. D. Balling. 1982. “The Field Trip Milieu: Learning and Behavior as a Function of Contextual Events.” *The Journal of Educational Research* 76 (1): 22–28.

Fančovičová, J., and P. Prokop. 2011. “Plants Have a Chance: Outdoor Educational Programmes Alter Students’ Knowledge and Attitudes towards Plants.” *Environmental Education Research* 17 (4): 537–551.

Farmer, A. J., and J. A. Wott. 1995. “Field Trips and Follow-up Activities: Fourth Graders in a Public Garden.” *The Journal of Environmental Education* 27 (1): 33–35.

Fröhlich, G., D. Sellmann, and F. X. Bogner. 2013. “The Influence of Situational Emotions on the Intention for Sustainable Consumer Behaviour in a Student-centred Intervention.” *Environmental Education Research* 19 (6): 747–764.

Gerstner, S., and F. X. Bogner. 2010. “Cognitive Achievement and Motivation in Hands-on and Teacher-centred Science Classes: Does an Additional Hands-on Consolidation Phase (Concept Mapping) Optimise Cognitive Learning at Work Stations?” *International Journal of Science Education* 32 (7): 849–870.

Gläser-Zikuda, M., S. Fuß, M. Laukenmann, K. Metz, and C. Randler. 2005. “Promoting Students’ Emotions and Achievement – Instructional Design and Evaluation of the ECOLE-approach.” *Feelings and Emotions in the Learning Process Feelings and Emotions in the Learning Process* 15 (5): 481–495.

Hammerman, W. M. 1980. *Fifty Years of Resident Outdoor Education: 1930–1980*. Indiana, IN: American Camping Association.

Hermann, N., and S. Menzel. 2013. “Threat Perception and Attitudes of Adolescents towards Re-introduced Wild Animals: A Qualitative Study of Young Learners from Affected Regions in Germany.” *International Journal of Science Education* 35 (18): 3062–3094.

Hothorn, T., F. Bretz, and P. Westfall. 2008. “Simultaneous Inference in General Parametric Models.” *Biometrical Journal* 50 (3): 346–363.

Johnson, D. W., and R. T. Johnson. 1991. *Learning Together and Alone*. Needham Heights, MA: Allyn and Bacon.

Johnson, D. W., G. Maruyama, R. Johnson, D. Nelson, and L. Skon. 1981. “Effects of Cooperative, Competitive, and Individualistic Goal Structures on Achievement: A Meta-analysis.” *Psychological Bulletin* 89 (1): 47–62.

Leeming, F. C., W. O. Dwyer, B. E. Porter, and M. K. Cobern. 1993. “Outcome Research in Environmental Education: A Critical Review.” *The Journal of Environmental Education* 24 (4): 8–21.

Liefländer, A. K., F. X. Bogner, A. Kibbe, and F. G. Kaiser. 2015. “Evaluating Environmental Knowledge Dimension Convergence to Assess Educational programme Effectiveness.” *International Journal of Science Education* 37 (4): 684–702.

Lienert, G. A., and U. Raats. 1994. *Testaufbau Und Testanalyse*. Weinheim: Julius Beltz.

Lindemann-Matthies, P. 2002. “The Influence of an Educational Program on Children’s Perception of Biodiversity.” *The Journal of Environmental Education* 33 (2): 22–31.

Lynn, W. S. 2010. “Discourse and Wolves: Science, Society, and Ethics.” *Society and Animals* 18 (1): 75–92.

Mayring, P., and C. V. Rhöneck. 2003. *Learning Emotions*. Frankfurt am Main: P. Lang.

Morag, O., and T. Tal. 2012. “Assessing Learning in the Outdoors with the Field Trip in Natural Environments (FiNE) Framework.” *International Journal of Science Education* 34 (5): 745–777.

Muhlenbruck, L., H. Cooper, B. Nye, and J. Lindsay. 2000. “Homework and Achievement: Explaining the Different Strengths of Relation at the Elementary and Secondary School Levels.” *Social Psychology of Education* 3 (4): 295–317.

Orion, N., and A. Hofstein. 1994. “Factors That Influence Learning during a Scientific Field Trip in a Natural Environment.” *Journal of Research in Science Teaching* 31 (10): 1097–1119.

Pekrun, R. 1992. “The Impact of Emotions on Learning and Achievement: Towards a Theory of Cognitive/Motivational Mediators.” *Applied Psychology* 41 (4): 359–376.

Prokop, P., G. Tuncer, and R. Kvasničák. 2007. "Short-term Effects of Field Programme on Students' Knowledge and Attitude toward Biology: A Slovak Experience." *Journal of Science Education and Technology* 16 (3): 247–255.

R Development Core Team. 2013. R: *A Language and Environment for Statistical Computing*. Vienna: R Foundation for Statistical Computing.

Randler, C., E. Hummel, M. Gläser-Zikuda, C. Vollmer, F. X. Bogner, and P. Mayring. 2011. "Reliability and Validation of a Short Scale to Measure Situational Emotions in Science Education." *International Journal of Environmental & Science Education* 6 (4): 359–370.

Rickinson, M., J. Dillon, K. Teamey, M. Morris, M. Y. Choi, D. Sanders, and P. Benefield. 2004. *A review of research on outdoor learning*. London: National Foundation for Educational Research and King's College.

Slavin, R. E. 1980. "Cooperative Learning." *Review of Educational Research* 50 (2): 315–342.

Slavin, R. E. 1996. "Research on Cooperative Learning and Achievement: What We Know, What We Need to Know." *Contemporary Educational Psychology* 21 (1): 43–69.

Slavin, R. E. 1983. "When Does Cooperative Learning Increase Student Achievement?" *Psychological Bulletin* 94: 429–445.

Stöhr, C., and E. Coimbra. 2013. "The Governance of the Wolf-human Relationship in Europe." *Review of European Studies* 5 (4): 1–18.

Tal, T., N. Lavie Alon, and O. Morag. 2014. "Exemplary Practices in Field Trips to Natural Environments." *Journal of Research in Science Teaching* 51 (4): 430–461.

United Nations. 1992. *Agenda 21*. New York: United Nations Department of Public Information.

Van Matre, S. 1990. *Earth Education: A New Beginning*. Greenville, WV: The Institute for Earth Education.

Värlander, S. 2008. "The Role of Students' Emotions in Formal Feedback Situations." *Teaching in Higher Education* 13 (2): 145–156.

Wells, N. M. 2000. "At Home with Nature: Effects of 'Greenness' on Children's Cognitive Functioning." *Environment and Behavior* 32 (6): 775–795.

Wilcox, R. R. 2012. *Introduction to Robust Estimation and Hypothesis Testing*. Amsterdam: Elsevier/Academic Press.

Zelezny, L. C. 1999. "Educational Interventions That Improve Environmental Behaviors: A Meta-analysis." *The Journal of Environmental Education* 31 (1): 5–14.

5.4 Teilarbeit B

Dieser, O. and Bogner, F. X. (2015)

How does hands-on outdoor learning influence children's environmental perception?

Journal of Environmental Education

(submitted)

How does hands-on outdoor learning influence children's environmental perception?

Olivia Dieser and Franz X. Bogner

University of Bayreuth, Bayreuth, Germany

Author Note

Olivia Dieser, Department of Biology Education, University of Bayreuth; Franz X. Bogner, Department of Biology, University of Bayreuth.

This article will be published in the *Journal of Environmental Education*, 2015, and available online at http://www.tandfonline.com/loi/vjee20.

The authors like to thank the National Park "Bavarian Forest" in particular, the "Jugendwaldheim, Wessley Haus" with R. Gaidies and her team for supporting and implementing the educational programme. Furthermore, we gratefully acknowledge M. Wiseman for valued comments on earlier drafts of our manuscript. Last but not least, we thank all students, teachers and volunteers involved in this study for cooperation.

Correspondence concerning this article should be addressed to Olivia Dieser, Department of Biology, University of Bayreuth, Bayreuth, Germany.

E-mail: olivia.dieser@uni-bayreuth.de

Abstract

The relationship between students and nature is regarded as very important. Fostering positive environmental attitudes and related knowledge was the main intention of our four-day residential outdoor education program in a National park. Using a pre-, post-, retention-test design, the 2-MEV attitudinal model was administered to monitor environmental perception, while knowledge development was scored by an *ad-hoc* questionnaire. The typical 2-MEV structure consisting of two higher-order factors "Preservation" and "Utilization" was again confirmed for all test cycles, while the mean scores remained constant over time. Both factors correlate positively with knowledge acquisition. Interrelations of program content, environmental perceptions and knowledge are discussed in relation to potential future implications.

Keywords: 2-MEV model, environmental attitudes, environmental knowledge, hands-on lesson, environmental education, primary school students, National park.

How does hands-on outdoor learning influence children's environmental perception?

In the last few decades, several studies concerning informal outdoor education interventions have been implemented to study students' environmental knowledge, attitude and behavior (e.g., Zelezny 1999, Dillon et al. 2006). Many of those studies reported knowledge achievement and significant positive changes toward more pro-environmental attitudes and behavior. Museums, zoos or field centers in National Parks provide such programs for schools as part of their extracurricular outdoor education initiatives. It is common sense that several factors influence the positive effects of such interventions. Very often, the program length itself is cited as a crucial variable, whereas others report the setting or the age of participants as important factors (Bogner 1998, Ballantyne and Packer 2002). Bogner (1998) for instance, showed a 5-day residential outdoor ecology education program to be more influential on young students' environmental attitudes than a day-long program.

However, in recent years, field centers or other outdoor education institutions have complained about decreasing participation (Pergams and Zaradic 2006). Natural resources nowadays are consumed faster than they are restocked. Additionally, the younger generation is supposed to be strongly media-, consumption- and efficiency-orientated and hence have less time and fewer possibilities to discover the natural environment (Currie et al., 2004; Langley, 2009; Pergams & Zaradic, 2006). It is therefore even more important that our adolescents become aware of all these changes and assume responsibility for "their" environment. Our children are the future responsible stakeholders of our world and its nature. Consequently, it is very important that they learn to handle our nature and environment in a sustainable way. The younger children get in closer contact with nature, the better they keep their interest in environmental conservation (Bogner & Wilhelm, 1996; Bogner & Wiseman, 2002). Empirical analyses have long failed to measure

environmental attitudes and behavior in psychometrically accepted quality (see meta-analyses: Leeming, Dwyer, & Bracken, 1995; Leeming, Dwyer, Porter, & Cobern, 1993). The first instruments attempted to measure mainly environmental perceptions of an anthropocentric or an ecocentric view (Arcury, Johnson, & Scollay, 1986; Blaikie, 1992; Dunlap & Van Liere, Kent D., 1978; Schneller, Johnson, & Bogner, 2013). Until the mid 1990ies, a lack of valid empirical instruments to measure children's environmental attitudes and behavior was apparent. Due to the introduction of environmental education at that time it became obligatory to have such an instrument. Bogner and Wilhelm (1996) as well as Bogner and Wiseman (1999) analyzed environmental perception using an instrument measuring two factors applicable for adolescents: Items were grouped into five primary factors and two higher-order factors labelled Preservation (PRE) and Utilization (UTL). A 20 item-scale was shown to quantify these constructs, 10 items measuring the PRE-factor covering subscales such as "Intent of Support", "Care with resources" and "Enjoyment of nature"; and 10 measuring UTL with subscales such as "Human Dominance" and "Altering Nature". In a further study, the item battery of the New Environmental Paradigm (NEP, Dunlap & Van Liere 1978, Dunlap et al. 2000) was integrated (Bogner & Wiseman, 2002). Once more, the now validated higher order structure of PRE and UTL could be identified. In a final study, the 10 highest loading items of PRE and UTL, respectively, were combined in the model of Environmental Values (2-MEV) (Bogner & Wiseman, 2006). Wiseman and Bogner (2003) described PRE as "a biocentric dimension that reflects conservation and protection of the environment" and UTL as "an anthropocentric dimension that reflects the utilization of natural resources" (p. 787).

The 2-MEV model provided a long awaited measurement of the environmental attitudes of adolescents, and research groups started to employ the instrument: Milfont and Duckitt (2004) were the first to examine and confirm the 2-MEV model. Although they

introduced many more primary factors, their second higher-order structure confirmed PRE and UTL. However, in their study, subjects were psychology freshmen in New Zealand with a limited range of age and backgrounds. In contrast, Johnson and Manoli (2008) applied the 2-MEV model to 5th and 6th graders, measuring environment values before and after participation in an earth education program. Again, they confirmed the higher-order structure of PRE and UTL, and reported a change toward more pro-environmental perceptions after the program. Other research groups using the 2-MEV model could independently confirm it as a consistent, reliable and highly valid instrument (Boeve-de Pauw & van Petegem, 2011; Liefländer & Bogner, 2014; Munoz, Bogner, Clement, & Carvalho, 2009; Schneller et al., 2013). Through the frequent application and confirmation of the 2-MEV model it is possible to compare environmental values of different age groups, different countries and also different environmental education programs. Several studies, for instance, have confirmed the orthogonal, robust and independent factors PRE and UTL proposed by Wiseman and Bogner (Johnson & Manoli, 2008; Munoz et al., 2009). In contrast, other studies in different settings varying within countries or programs have reported significant correlations between PRE and UTL, indicating any relation of the two factors (Liefländer & Bogner, 2014; Milfont & Duckitt, 2004; Schneller et al., 2013).

In our study, we developed an environmental outdoor education program in the oldest National Park of the country. Our subjects participated in a four-day National park program "Let nature remain nature!" highlighting the unique forest ecology of the region as well as the issue of re-introducing wild animals. The program was structured with hands-on activities to foster the students' feeling of nature and to create positive attitudes (Bogner, 1998; Kellert 2002). Additionally, we were interested in the cognitive achievement due to the intervention and its connection with the environmental attitudes. Environmental perception was measured using the 2-MEV battery, and cognitive outcome

was scored using an ad-hoc questionnaire described in more detail elsewhere (Dieser & Bogner, submitted).

The objectives of our study were three-fold: First, to monitor the stability of the MEV-structure at all three measurement points. Second, to analyze PRE and UTL scores in relation to our program. Third, to examine the influence of high PRE-scores and low UTL-scores on knowledge level.

Methods

Participants and Procedure

Our study in a National Park involved 333 fourth and fifth graders (53.8 % girls, mean age = 10.02 ± .83) from local schools. In a quasi-experimental design, students completed a pencil-and-paper questionnaire consisting of the 2-MEV model (2 factor Model of Environmental Values) and an *ad hoc* knowledge test. The 2-MEV model measured the factors of Preservation (PRE) and Utilization (UTL). For this study, we selected 16 of 20 items with the highest loadings to keep the questionnaire short and to adapt the scale to the cognitive capacity of young students (Liefländer & Bogner, 2014); Table 1). A 5-point Likert scale was employed, varying from "strongly disagree" (1) to "strongly agree" (5). The knowledge questionnaire consisted of 15 multiple choice items, with four possible answers including only one correct option. The students completed the questionnaires three times: The pre-test (T0) was applied at school up to two weeks before the intervention. Immediately after participation, the post-test was completed in the National Park and again four to six weeks after the intervention, the retention test was completed back at school. Items were randomly arranged at each testing cycle. Teachers of our participating classes were instructed not to teach or discuss any of the program content before and until T2. The post-test reliability of Cronbach's alpha was .72 for the UTL, .87

for the PRE scale and .51 for the knowledge questionnaire, which is sufficient for an ad-hoc questionnaire to compare groups (Lienert & Raats, 1994).

[Table 1 near here]

Environmental Education Program

Our week-long environmental education program integrated mainly hands-on activities and affective experiences close to nature. The outdoor program was completed in the National Park "Bavarian Forest" in small subgroups of about 12 students, led by an outdoor educator. The program consisted of a 4 hour section in the morning and again in the afternoon. The thematic focus was on forest ecology characteristics as well as on species conservation. Each session was implemented in a specific part of the National Park to focus on an explicit issue. For instance, a visit of a treetop-path allowed the students to recognize the height of the trees and to learn the differences between several tree species. On the so-called *adventure day* the forest, the meadows or a moor were investigated. Wolf and lynx were emphasized as self-reintroduced animals in Germany by highlighting selected contents of natural history including behavior in the light of possible existing prejudices towards these animals. Simple role games were implemented to elucidate the familiar situation of a wolf family or the hunting behavior of the lynx. Outdoor educators provided guidance for the small subgroups through the forest by providing selected knowledge about the program contents. For a more detailed program description, refer to Dieser and Bogner (2014, submitted).

Statistical Analysis

Analyses were completed by using IBM SPSS Statistics 21. A principal axis factor analysis (PAF) was conducted to validate the 2-MEV's factor structure at all testing cycles. Additionally, the Kaiser-Meyer-Olkin (KMO) test was used to examine sampling

adequacy. For further analyses factor scores were used. Comparisons of the 2-MEV outcomes were examined with a non-parametric Friedman test, since data were found to be non-normally distributed ($p < .05$). However, for a better understanding the figures we show as mean scores. Correlations were analyzed by using Spearman's Rho correlation coefficient. For correlations between the PRE, UTL and knowledge, mean scores were used.

Results

The principal axis factor analysis with oblique rotation (direct oblimin) confirmed the two-factor structure of PRE and UTL (Table 2). Also, the Kaiser-Meyer-Olkin (KMO) test showed significant and high values for all measurement points confirming the sampling adequacy (Hutcheson & Sofroniou, 1999); T0: KMO = .82, T1: KMO = .87, T2: KMO = .89; $p < .001$). Barlett's Test of sphericity ($chi\text{-}squared_{T0}$ (120) = 1048.45, $chi\text{-}squared_{T1}$ (120) = 1526.88, χ^2_{T2} (120) = 1864.57, $p < .001$), indicates that items correlations were sufficiently large for PAF. The total variance explained was 38.1 % for T0, 44.0 % for T1 and 47.5 % for T2. The mean Cronbach's alpha for PRE was .85 ($alpha_{T0}$ = .81, $alpha_{T1}$ = .87, $alpha_{T2}$ = .88) and for UTL .73 ($alpha_{T0}$ = .69, $alpha_{T1}$ = .72, $alpha_{T2}$ = .77).

[Table 2 near here]

Mean scores of the 2-MEV model showed no significant difference between T0, T1 and T2 for Preservation and Utilization at the three different measurement points (Friedman: $p > .05$; Figure 1).

[Figure 1 near here]

Correlation between PRE and UTL showed negative and highly significant correlations for all measurement points (r_{T0} = -.307, r_{T1} = -.417, r_{T2} = -.487, all p (*1-tailed*) < .001), meaning higher preferences in PRE involving lower ones in UTL. Appling a Bonferroni correction (corrected: $p \leq .005$) did not change significances.

At all three measurement points, no gender effect was identified, neither in PRE ($p > .05$) nor in UTL ($p > .05$).

Correlations between the 2-MEV scores and the cognitive achievement are shown in table 3. PRE and knowledge at T1 and T2 correlated positively and negatively for UTL and knowledge at all three measurement points (Table 3).

[Table 3 near here]

Discussion

Environmental perception shift during an environmental education program

Confirmation of the 2-MEV structure again was not surprising, taking the repeated confirmation studies of different groups into account (Milfont & Duckitt, 2014; Johnson & Manoli, 2008; Boeve-de Pauw & Petegem 2011; Liefländer & Bogner, 2014). This is even true of those studies used a reduced item set: Schneller and colleagues (2013), for instance, applied just 12 items to a Mexican sample, but still extracted the two higher order factors of PRE and UTL. Our 16-item battery also turned out as sufficient to support the bi-dimensional structure. A lower number of items make its application in outdoor studies more likely. The innovative approach of our study, however, was its repeated application. To our knowledge, no studies up to now have factor-analyzed the 2-MEV model's consistency over thrice repeated testing cycles. Our results clearly confirmed the dichotomous structure as maintaining over the three measurement points, even with a

constancy of loading patterns. Thus, we again confirm the two-dimensional structure of the MEV-model.

Nevertheless, program participation did not produce changes, neither in PRE nor in UTL, quite in contrary to our expectation, which had focused on an increase of PRE values with a concomitant decrease of UTL values. Previous studies confirmed that interventions with 4 days duration might have the capacity to do so. For instance, Bogner (1998; 1999; 2002) implemented three different outdoor education programs with various foci in different countries and obtained effects on environmental perception: Depending on the program, different primary factors of the 2-MEV model were affected. The first study, also in the Bavarian National Park focused on a face-to-face nature experience, showed perception changes only for the PRE domain. Similarly, the second study focusing on a conservation program of an endangered bird species affected the preservation domain. That study, however, concentrated on cognitive aspects of the education program producing shifts in the utilitarian domain. In contrast, evaluation of an earth education program yielded an overall increased pro-environmental perception (Johnson & Manoli, 2008). Noticeable here is the fact, that in first two studies of Bogner (1998; 1999) and that of Johnson and Manoli (2008) the interventions were centered on conservational issues with an effect of positive changes in PRE and/or UTL. However, we did not explicitly generate specific situations focusing on the current environmental situation or the conservation status of our forests and influences of humans on nature. Our hands-on experiences apparently did not “transfer” the importance of nature conservation.

We observed no gender differences, which is quite in line with Liefländer and Bogner (2014). Although previous studies reported higher PRE and lower UTL values for girls indicating a higher pro-environmental attitude (Bogner, 1999; Bogner & Wiseman, 2006; Wiseman & Bogner, 2003), other studies, for instance, found only differences for the

UTL value with higher scores for boys (Boeve-de Pauw & van Petegem, 2011). This may result from the different programs in which students were participating or the different school background of the students. Some authors, for instance, only measured the status quo of environmental attitudes from students with different school backgrounds (Boeve-de Pauw & van Petegem, 2011; Bogner, 1999; Bogner & Wiseman, 2006; Wiseman & Bogner, 2003). The content of these environmental education programs did not specifically enhance the pro-environmental attitude of students. However, these findings show our program to be suitable for both boys and girls. In contrast, asking students in the context of their everyday life, boys and girls might be different positively or negatively influenced by their social environment (Schultz, 2002).

Summarizing our results of the 2-MEV model, it is clear that PRE and UTL are two distinct but also negatively related factors. PRE as an eco-centric dimension measures the conservational and environmental protective attitudes of adolescents, whereas UTL as an anthropocentric dimension reflects the exploitative usage of nature. Items like “I often try to persuade others that the environment is an important thing” or “Only plants and animals of economical importance need to be protected“ were submitted to the students. However, the content of these items was not comparable with the content of our program, whose intent was to bring students back to nature, to foster appreciation of nature and to change individual environmental attitudes, which may finally result in changed environmental behavior. However, our students were not specifically instructed about nature protection or behavioral use of National parks or economical forests. Therefore, for environmental education programs it seems essential to foster pro-environmental attitudes by specifically focusing on environmental values.

Influence of an environmental education program on students' Environmental Perception and Knowledge

During the last 30 years, many studies have dealt with uncovering the relationship between environmental knowledge, attitudes and behavior. One of the first and simplest models, the linear model, suggested that pro-environmental knowledge would lead to more environmental awareness and concern, which in the end foster pro-environmental behavior (Burgess, Harrison, & Filius, 1998). Many other studies followed recognizing that there are many more factors influencing the development and change of environmental attitude and behavior (Kollmuss & Agyeman, 2002). Up to now, no final model is accepted which clearly explains this relationship. However, many studies, especially in environmental education acquire at least one of these factors in order to test whether the educational program or situation can change towards more pro-environmental attitudes or behavior. Although many more factors are presumed to influence this relationship, still mainly knowledge, attitudes and behavior are measured in an attempt to discover possible relations. In our present study, the knowledge items referred to the program content and therefore mainly to factual knowledge. Nevertheless, analyses between knowledge and the environmental values showed significant negative correlations with UTL at all three measurement points and significant positive correlations with PRE at post and retention test. Additionally, small correlational tendencies within the pre-test lost significance after Bonferroni correction application. Therefore, UTL may have a cognitive influence at all test points, whereas PRE appears to have only a cognitive influence after the program. Several reasons may have contributed to these results: Some authors refer to the age of the students, arguing that younger students as more amenable to improve knowledge and simultaneously environmental attitudes (Bogner, 1999; Bogner & Wiseman, 2004). In our present study with only a small effect of PRE and UTL on knowledge, we do not see age as a strong influencing factor on environmental attitudes.

In contrast, the background and content of an environmental program seem to be a much stronger factor influencing this relationship when measuring environmental knowledge and attitudes. There are various studies analyzing this relationship, but yielding different results (Boeve-de Pauw & van Petegem, 2011; Bogner, 1999; Fremerey & Bogner, 2015). Bogner (1999) reported significant positive correlation between knowledge and some PRE aspects, and negative ones with UTL. However, the Bogner (1999) study worked with difference scores. Apart from this, the results of our study are still comparable to this one, since the program contained inside but also outside approaches with the purpose of bringing adolescents in close contact with nature on a specific issue. Unlike the study of Fremerey and Bogner (2015), the only significant correlations between PRE and knowledge values were observed at the post- and retention test, but none between UTL and PRE. This program consisted of a media section followed by an authentic tour. In contrast to our program, no hands-on activities were involved. However, high PRE perceptions produced a high cognitive learning outcome. Bouve-de Pauw and Petegem (2011) found significant positive correlations between environmental affect and PRE scores and significant negative correlations between knowledge and UTL while monitoring Flemish eco school outcomes. The authors explain the results as mirroring the focus of the eco-school which concentrates on teaching environmental knowledge rather than environmental attitudes or behavior. Therefore, the UTL values might show an influence due to knowledge levels, whereas the PRE values were only influenced by environmental affect. This may also explain why in our study PRE values correlated significantly only after the program. Before program participation, students were asked factual knowledge questions of the National Park issue with no context to PRE of nature and no further emotional connections to this topic. UTL preferences in contrast are part of the daily life students are confronted with. However, during the program students were confronted each day with affective nature approaches. As a consequence, the PRE values of some students

were addressed, leading to a higher willingness to learn. UTL values were not reduced through the program and had also no further influence on the knowledge. Kibbe and colleagues (2014) suggested that only positive and affective nature experiences may lead to a change in environmental attitudes. However, our program was designed with all that positive and affective hands-on experiences, but concrete examples and an explicit examination with nature conservation and sustainable behavior was not implemented. This additionally supports the hypotheses that the content of an educational program needs to include specifically environmental issues to address the students' attitudes.

Another reason why in our case PRE scores differed from the pre-test may lie in the social desirability tendency of adolescents. Oerke and Bogner (2013) had described such an influence of adolescents' "lie" scores on the 2-MEV model, especially in PRE scores. The scoring pattern in our study may point to such an influence of the social desirability since our pre-test scored relatively high in PRE. This is not surprising, since PRE is more likely to represent a more self-reported behavior. Therefore, these higher PRE preferences could originate from responses designed to present themselves in a better position. In contrast, after the program the statements of the students may correspond more to the truth and could thus influence the students' knowledge.

In conclusion, this study confirms that knowledge influences environmental attitudes in a certain way and vice versa, but it remains open which are the most important variables having an influence on both factors.

References

Arcury, T. A., Johnson, T. P., & Scollay, S. J. (1986). Ecological Worldview and Environmental Knowledge: The "New Environmental Paradigm". *The Journal of Environmental Education, 17*(4), 35–40. doi:10.1080/00958964.1986.9941424

Ballantyne, R. & Packer, J. (2002). Nature-based excursions: school students' perceptions of learning in natural environments. *Internal Research in Geographical and Environmental Education, 11*(3), 218-236.

Blaikie, W. H. (1992). The Nature and Origins of Ecological World Views: An Australian Study. *Social Science Quarterly, 73*(1), 144–165.

Boeve-de Pauw, J., & van Petegem, P. (2011). The Effect of Flemish Eco-Schools on Student Environmental Knowledge, Attitudes, and Affect. *International Journal of Science Education, 33*(11), 1513–1538. doi:10.1080/09500693.2010.540725

Bogner, F. X. (1998). The influence of short-term outdoor ecology education on long-term variables of environmental perspective. *The Journal of Environmental Education, 29*(4), 17–29.

Bogner, F. X. (1999). Empirical evaluation of an educational conservation programme introduced in Swiss secondary schools. *International Journal of Science Education, 21*(11), 1169–1185. doi:10.1080/095006999290138

Bogner, F. (2002). The influence of a residential outdoor education programme to pupil's environmental perception. *European Journal of Psychology of Education, 17*(1), 19-34. doi:10.1007/BF03173202

Bogner, F. X., & Wilhelm, M. G. (1996). Environmental perspectives of pupils: the development of an attitude and behaviour scale. *The Environmentalist, 16,* 95–110.

Bogner, F. X., & Wiseman, M. (1999). Toward measuring adolescent environmental perception. *European Psychologist, 4*(3), 139-151.

Bogner, F. X., & Wiseman, M. (2002). Environmental perception: Factor profiles of extreme groups. *European Psychologist, 7*(3), 225–237.

Bogner, F. X., & Wiseman, M. (2004). Outdoor Ecology Education and Pupils' Environmental Perception in Preservation and Utilization. *Science Eduation International, 15*(1), 27–48.

Bogner, F. X., & Wiseman, M. (2006). Adolescents' attitudes towards nature and environment: Quantifying the 2-MEV model. *The Environmentalist, 26*(4), 247–254. doi:10.1007/s10669-006-8660-9

Burgess, J., Harrison, C. M., & Filius, P. (1998). Environmental communication and the cultural politics of environmental citizenship. *Environment and Planning A, 30*(8), 1445–1460.

Currie, C., Roberts, C., Morgan, A., Smith, R., Settertobulte, W., Samdal, O., & Barnekow Rasmussen, V. (2004). *Young people's health in context. Health Behaviour in School-aged Children (HBSC) study: international report from the 2001/2002 survey*. Copenhagen.

Dieser, O. & Bogner, F. X. (2014). Young peoples' cognitive achievement as fostered by a hands-on-centred environmental education programme. Manuscript submitted for publication.

Dillon, J., Rickinson, M., Teamey, K., Morris, M., Choi, M. Y., Sanders, D., & Benefield, P. (2006). The value of outdoor learning: evidence from research in the UK and elsewhere. *School Science Review, 87*(320), 107-111.

Dunlap, R. E., & Van Liere, Kent D. (1978). The “New Environmental Paradigm”. *The Journal of Environmental Education, 9*(4), 10–19. doi:10.1080/00958964.1978.10801875

Fremerey, C., & Bogner, F. X. (2015). Cognitive learning in authentic environments in relation to green attitude preferences. *Studies in Educational Evaluation*, *44*, 9-15.

Hutcheson, G., & Sofroniou, N. (1999). *The multivariate social scientist*. London: Sage.

Johnson, B., & Manoli, C. C. (2008). Using Bogner and Wiseman’s Model of Ecological Values to measure the impact of an earth education programme on children’s environmental perceptions. *Environmental Education Research, 14*(2), 115–127. doi:10.1080/13504620801951673

Kellert, S. R. (2002). Experiencing nature: Affective, cognitive, and evaluative development in children. In P. H. Kahn & S. R. Kellert (Eds.), *Children and nature: Phyiological, socicultural, and evolutionary investigations* (pp. 117–151). Cambridge, Massachusetts: Massachusetts Institute of Technology.

Kibbe, A., Bogner, F. X., & Kaiser, F. G. (2014). Exploitative vs. appreciative use of nature – Two interpretations of utilization and their relevance for environmental education. *Studies in Educational Evaluation, 41,* 106–112. doi:10.1016/j.stueduc.2013.11.007

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research, 8*(3), 239–260. doi:10.1080/13504620220145401

Langley, J. L. (2009). Curing Nature-Deficit Disorder: How Environmental Education Helps Kids Learn. *Honors College Capstone Experience/Thesis Projects, Paper 263*.

Leeming, F. C., Dwyer, W. O., & Bracken, B. A. (1995). Children's Environmental Attitude and Knowledge Scale: Construction and Validation. *The Journal of Environmental Education, 26*(3), 22–31. doi:10.1080/00958964.1995.9941442

Leeming, F. C., Dwyer, W. O., Porter, B. E., & Cobern, M. K. (1993). Outcome Research in Environmental Education: A Critical Review. *The Journal of Environmental Education, 24*(4), 8–21. doi:10.1080/00958964.1993.9943504

Liefländer, A. K., & Bogner, F. X. (2014). The effects of children's age and sex on acquiring por-environmental attitudes through envrionmental education. *The Journal of Environmental Education, 45*(2), 105–117.

Lienert, G. A., & Raats, U. (1994). *Testaufbau und Testanalyse*. Weinheim, Berlin, Basel: Julius Beltz.

Milfont, T. L., & Duckitt, J. (2004). The structure of environmental attitudes: A first- and second-order confirmatory factor analysis. *Journal of Environmental Psychology, 24*(3), 289–303. doi:10.1016/j.jenvp.2004.09.001

Munoz, F., Bogner, F., Clement, P., & Carvalho, G. S. (2009). Teachers' conceptions of nature and environment in 16 countries. *Journal of Environmental Psychology, 29*(4), 407–413. doi:10.1016/j.jenvp.2009.05.007

Oerke, B., & Bogner, F. X. (2013). Social Desirability, Environmental Attitudes, and General Ecological Behaviour in Children. *International Journal of Science Education, 35*(5), 713–730. doi:10.1080/09500693.2011.566897

Pergams, O. R. W., & Zaradic, P. A. (2006). Is love of nature in the US becoming love of electronic media? 16-year downtrend in national park visits explained by watching movies, playing video games, internet use, and oil prices. *Journal of Environmental Management, 80*(4), 387–393. doi:10.1016/j.jenvman.2006.02.001

Schneller, A. J., Johnson, B., & Bogner, F. X. (2013). Measuring children's environmental attitudes and values in northwest Mexico: validating a modified version of measures to test the Model of Ecological Values (2-MEV). *Environmental Education Research,* 1–15. doi:10.1080/13504622.2013.843648

Schultz, W. (2002). Knowledge, Information and Household Recycling: Examining the Knowledge-Deficit Model of Behavior Change. In T. Dietz & P. Stern (Eds.), *Education, Infomation and voluntary measures in environmental perception* (pp. 67–82). Washington DC: National Acadamy of Science.

Wiseman, M., & Bogner, F. X. (2003). A higher-order model of ecological values and its relationship to personality. *Personality and Individual Differences, 34*(5), 783–794.

Zelezny, L. C. (1999). Educational interventions that improve environmental behaviors: A meta-analysis. *The Journal of Environmental Education, 31*(1), 5–14.

Table 1

Listing of the shortened 2-MEV model with 16 individual items

	Preservation (8)
MEV 09	If I ever get extra pocket money, I will donate some money to an environmental organization.
MEV 10	Environmental protection costs a lot of money. I am prepared to help out in a fund-raising effort.
MEV 04	I have helped at least once in the past, outside of school hours, to collect rubbish in the countryside.
MEV 06	When I am older I am going to join and actively participate in an environmentalist group should I already not be a member.
MEV 07	I often try to persuade others that the environment is an important thing.
MEV 03	I would really enjoy sitting at the edge of a pond, watching dragonflies in flight.
MEV 08	I have a sense of well-being in the silence of nature.
MEV 14	I really like to be able to go on trips into the countryside - for example to forests or fields.
	Utilization (8)
MEV 15	Plants and animals just exist for the benefit of humans.
MEV 01	People worry too much about pollution.
MEV 12	Humans have the right to change nature as they see fit.
MEV 16	Human beings are more important than other creatures.
MEV 05	Worrying about the environment often holds up development projects.
MEV 13	Humans were meant to rule over the rest of nature.
MEV 11	Only plants and animals of economical importance need protection.
MEV 02	We need to clear forests in order to grow crops.

Table 2

Factor pattern of 16 item loading for PRE and UTL at the three measurement points

	T0			T1			T2	
Item	PRE	UTL	Item	PRE	UTL	Item	PRE	UTL
MEV 10	.731		MEV 09	.768		MEV 09	.855	
MEV 09	.720		MEV 04	.749		MEV 10	.811	
MEV 06	.692		MEV 10	.729		MEV 04	.794	
MEV 07	.591		MEV 06	.724		MEV 06	.787	
MEV 03	.573		MEV 07	.649		MEV 07	.638	
MEV 04	.547		MEV 03	.608		MEV 03	.583	
MEV 08	.495		MEV 14	.604		MEV 08	.536	
MEV 14	.357		MEV 08	.535		MEV 14	.436	
MEV 15		.599	MEV 15		.588	MEV 15		.652
MEV 12		.581	MEV 12		.576	MEV 01		.592
MEV 16		.538	MEV 02		.562	MEV 12		.580
MEV 13		.482	MEV 16		.518	MEV 16		.568
MEV 11		.462	MEV 11		.480	MEV 05		.526
MEV 01		.445	MEV 13		.463	MEV 13		.511
MEV 02		.354	MEV 01		.423	MEV 11		.475
MEV 05		.240	MEV 05		.353	MEV 02		.364

Table 3

Correlations between factor scores of PRE and UTL and mean scores of knowledge

(1-tailed)

	KN 0	KN 1	KN 2
PRE 0	**.115**	**.178**	**.181**
	.022	.001	.001
UT 0	**-.266**	**-.298**	**-.284**
	<.001	<.001	<.001

Note. After Bonferroni correction $p \leq .008$ indicates significant effects.

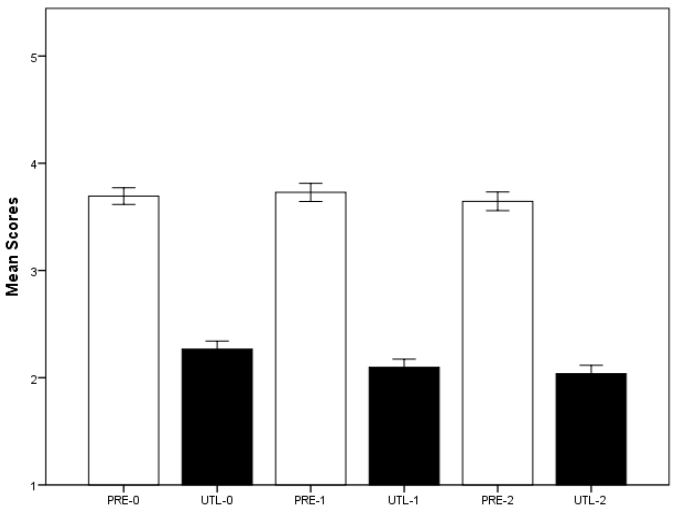


Figure 1: Graphical representation of PRE- and UTL-item mean scores at the three measurement points. Note: Bars are 95% confidence interval (CI).

5.5 Teilarbeit C

Dieser, O. and Bogner, F. X. (2015)

Intervention impact on young students' associations about wolf and lynx

Society and Animals

(submitted)

Intervention impact on young students' associations about wolf and lynx

Olivia Dieser and Franz X. Bogner

University of Bayreuth, Bayreuth, Germany

Author Note

Olivia Dieser, Department of Biology Education, University of Bayreuth; Franz X. Bogner, Department of Biology, University of Bayreuth.

This article will be published in the Journal *Society and Animals*, 2015, and available online at http://www.brill.com/society-animals.

The authors like to thank the National Park "Bavarian Forest" in particular, the "Jugendwaldheim, Wessley Haus" with R. Gaidies and her team for supporting and implementing the educational program. Furthermore, we gratefully acknowledge M. Wiseman for valued comments on earlier drafts of our manuscript. Last but not least, we thank all students, teachers and volunteers involved in this study for cooperation.

Correspondence concerning this article should be addressed to Olivia Dieser, Department of Biology Education, University of Bayreuth, Universitätsstr. 30, 95447 Bayreuth, Germany.

E-mail: olivia.dieser@uni-bayreuth.de

Abstract

Large carnivores such as wolves and lynxes have recently been re-established in some regions of Germany. Whereas in Scandinavia attitudes and related knowledge about these animals were occasionally monitored, in Mid-Europe only scattered expertise about public awareness exists. Therefore, this study focused on determining associations about wolves and lynxes among young students and, secondly, on its potential to change their associations positively through a short-term outdoor intervention. A sample of 4th and 5th graders (n = 311) observed wolves and lynxes in animal ground enclosures of a National park and participated in a hands-on environmental education program. Word associations of the stimuli words "wolf" and "lynx" were collected in a quasi-experimental pre-, post- and retention test design. Results of the pre-test indicated a prevailing negative picture of these animals, especially of the wolf. After the intervention, the negative image of these animals decreased and important background knowledge of the animals increased. Taking these shifts into account, more information about wild animals in general and reintroducing ones in particular are needed in German schools.

Keywords: lynx, outdoor education, primary school, word associations, wolf

Introduction

Wolves (*Canis lupus*) and lynxes (*Lynx lynx*) were eradicated during the 18th and 19th centuries in Germany as well as in the most parts of Europe. Threats to livestock and competition to game species were the most common reasons for many European administrations to foster killing these animals and to even pay bounties for (Breitenmoser, 1998). At the same time, folktales and myths especially focusing on wolf multiplied and developed prejudices contributing to a negative picture, presenting the animal as aggressive, children killers, rogue, beast and werewolf (Zimen, 2003). Consequently,

general attitudes toward these animals were very negative and persisted over a long period (e.g., Bjerke, Reitan, & Kellert, 1998; Ericsson & Heberlein, 2003). However, in recent decades wolf and lynx have been recovering in Scandinavia and Eastern Europe and have even immigrated back to Germany (Ericsson & Heberlein, 2003; Kleiven, Bjerke, & Kaltenborn, 2004; Kramer-Schadt, Revilla, & Wiegand, 2005; Liukkonen, Mykrä, Bisi, & Kurki, 2009; Müller et al., 2014; Reinhardt, Kluth, Nowak, & Mysłajek, 2013). Since the 1970s lynx became reintroduced into several forest regions of Germany, but also a slow recolonization to the Bavarian Forest occurred independently (Kramer-Schadt, Revilla, & Wiegand, 2005; Wölfl et al., 2001). Today, lynx population in Germany can be found in Eastern Bavaria as well as in the Harz Forest. Additionally, some individuals migrating through Germany were also registered (BfN, 2014). The first reproduction effort of a settled wolf pack in Germany could be registered in the active military grounds of Saxony in 2000 (Reinhardt, Kluth, Nowak, & Mysłajek, 2013). From there the population distributed to the region of north-east Saxony and south-east Brandenburg. In 2011, at least 14 wolf packs were established in Germany (Reinhardt, Kluth, Nowak, & Mysłajek, 2013).

The recolonization of wolf and lynx in Germany are accompanied by many projects and management plans developed to ensure the species' conservation and to work on a positive coexistence of humans and predators. Studies analyzing the general acceptance of wolf and lynx in Germany and neighboring countries found positive attitudes by the majority of people. However, farmers and hunters in these areas are concerned about this environmental development and are still seen as the most problematic stakeholders group (Hunziker, Hoffmann, & Wild-Eck, 2001; Kaczensky, 2006; Reinhardt, Kluth, Nowak, & Mysłajek, 2013). Nevertheless, educational work in the involved areas seems to have a positive influence on the public attitudes and knowledge (Kaczensky, 2006; Reinhardt, Kluth, Nowak, & Mysłajek, 2013).In contrast, comparable studies of public perception of

the large predators conducted in Scandinavia indicate moderate attitudes in general, but differ between groups of age, living situation and level of education (Bjerke, Reitan, & Kellert, 1998; Ericsson & Heberlein, 2003; Kleiven, Bjerke, & Kaltenborn, 2004; Liukkonen, Mykrä, Bisi, & Kurki, 2009). Older people, rural residents and farmers who suffer an economic loss, as well as people with a low level of education were found to have more negative attitudes towards the animals (Bjerke, Reitan, & Kellert, 1998; Kleiven, Bjerke, & Kaltenborn, 2004). Additionally, it became very obvious that especially hunters or people living in wolf or lynx areas show more negative attitudes, whereas the urban public indicated more positive attitudes (Ericsson & Heberlein, 2003; Liukkonen, Mykrä, Bisi, & Kurki, 2009). However, hunters and people living in Scandinavian predator areas often were not integrated into the management discussion (e.g., Kleiven, Bjerke, & Kaltenborn, 2004; Liukkonen, Mykrä, Bisi, & Kurki, 2009) which consequently let the people feel alone and increases the conflicting potential. Conflicts, fears, attitudes and knowledge depend on general and social processes (Scarce, 1998). The more a specific issue becomes presented in the media, the more interesting and important becomes such an issue for the public (Kaczensky, 2006). In Germany, the return of wolf and lynx have never been represented in an extremely media hype. Reports about these animals were given controlled and in most cases with positive information for the public (Kaczensky, 2006; Wölfl, 2012). Neverthelesss, the question about influences of such social processes, political decisions and media may also entrench the children's level by potentially producing fears, attitudes and knowledge regarding the wolf and lynx.

In recent decades, only a few studies analyzed adolescent attitudes, knowledge and fears about animals (Bath & Farmer, 2000; Bjerke, Ødegårdstuen, & Kaltenborn, 1998; Hermann & Menzel, 2013; Hovardas & Korfiatis, 2012; Kellert, 1985). Bjerke and colleagues (1998) found that younger and rural respondents (aged 9-13) regard wolves as scary and dangerous. Especially children living in a "wolf area" with its intense debates

about their new presence showed more negative attitudes compared to children living further away. Bjerke and colleagues (1998) therefore assumed these children to be affected by the ongoing conflict about management strategies. In general, they found decreasing interest in animals with increasing age of the children and in those living in rural regions. Kellert (1985) nevertheless reported contradicting results: Younger children showed far less interest in animals, particularly in wildlife; attitudes were described as very negative (active avoidance of animals due to dislike or fear) or dominant (mastery and control of the animals). Older children, in contrast, showed more ecologistic (concern for the environment as a system) and moralistic (concern for the right and wrong treatment of animals) attitudes toward animals. However, related knowledge in general was very poor among all children, but even worse among younger ones. Most knowledge concerned typical biological characteristics, basic and ecological knowledge was less, and knowledge of endangered species very much less. Kellert (1985) therefore identified three stages in the development of children's perception of animals: The youngest expressed more emotional concern and affection for animals; 5th to 8th graders developed factual and cognitive understanding of animals, whereas 8th to 11th graders expressed more ethical and ecological concern for animals. Some more recent studies have confirmed those concerns (Bath & Farmer, 2000; Hermann & Menzel, 2013). Nevertheless, Bath and Farmer (2000) reported positive correlation between knowledge levels and positive attitudes towards the carnivores, which may lead to support for protection efforts for the species under discussion.

Additionally, fear and threat seem to play an important role in the development of attitudes towards specific animals. Fears often develop through perceived danger and harm in the presence of an animal inducing negative views (Bath & Farmer, 2000; Johansson & Karlsson, 2011): negative attitudes tend to act as barriers against supporting species conservation (Bath & Farmer, 2000; Hermann & Menzel, 2013). Especially for children,

fear acts as a strong influencing factor on knowledge and attitudes. Several studies supported the negative correlation of anxiety with knowledge achievement (for review see Rosenfeld, 1978). In addition, the middle childhood (aged 6 – 12) is regarded as an imprinting period, where tales, legends, stories and myth enchant students (Kellert, 1997). Once more, this relationship prompts the question whether young students' knowledge and attitudes may be influenced by common fairytales, myth, but also media like films presenting especially the wolf in a negative manner.

In summary, a need exists to analyze young students' perceptions, attitudes and knowledge about wild animals. However, although recent studies showed more positive and highly moralistic views of rural adolescents and adults towards wolves and wild animals in general, individual knowledge about reintroduced animals still seems fragmented (Bath & Farmer, 2000; Hermann & Menzel, 2013; Kellert, 1993). Including the young students' perception and attitudes toward these species, they may better understand conflicts of controversial issues like the reintroduction of wolf and lynx. Therefore, this present study focused on basic and biological knowledge and the situation of wolf and lynx in Germany where both have been re-established. Kellert (1985) identified younger students' attitudes toward animals by characterizing major emotional concern and affection, and hence we implemented a short-term and mainly hands-on based educational program in the animal ground of a National park. The objectives of our study were to obtain cognitive and emotional links towards these animals by using the word association method. We also analyzed, if possibly media, fairy tales and myth influenced the young students' answers.

Sample and Procedures

The environmental education program was completed by 311 students of 4^{th} and 5^{th} graders (43.7 % girls, mean age ± SD = 10.03±.82) of local schools in the animal ground

of the National park Bavarian Forest. The schools are located in cities with a population between 6,000 to 1,400,000 inhabitants in Bavaria. Permission to gather other socio-demographic background (e.g., the living situation) was granted by the Bavarian ministry of Education. Students participated voluntarily and with the assent of their parents and teachers were assigned for a week-long visit in the National Park. Since open questions seem to be too complicated to answer at this age and the aim of the study was to recieve an overview of students' knowledge and emotional view towards wolf and lynx, we decided for the word association method. Students' associations were recorded in a quasi-experimental design using paper-and-pencil-questionnaires. The students were asked to list the first six words coming to their mind for the two stimuli words *wolf* and *lynx*. Six words were seen sufficient to firstly conveying enough information and secondly to not overstrain the students. To analyze changes in the students' responsiveness the word association task was applied three times. First, up to two weeks before the visit in the National park (T0), second directly after the program (T1) and last, four to six weeks after participation at the program (T2).

The students participated at a residential week-long program in the National Park Bavarian Forest. The program's intent was to foster individual connection to nature and to support individual enjoyment of spending time outside. Additionally, nature and species conservation were an important part. The students participated in small groups of seven to twelve students guided by an experienced outdoor educator. The different topics were treated in two four-hour sessions, one in the morning and one in the afternoon. All instructions were based on original encounter, hands-on and affective approaches. The park's characteristic forest ecology and species conservation were addressed. A major thematic focus was laid on the two reintroduced animals wolf and lynx in Germany. To learn about the biology of these animals and natural history aspects in the light of existing prejudices, the students visited the National park's Animal Ground. Apart from getting

acquainted with other local animals there, wolves and lynxes in large enclosures were the main focus. Within an observation task, the students focused on understanding some of the animals' behaviors (such as a wolf putting his tail between his hind legs); the outdoor educators discussed the specific behavior pattern in context with the social system. The outdoor educators especially highlighted the difference of a free living wolf pack and a pack kept in enclosures. Through the analysis of the enclosures' arrangement the students recognized, how the natural habitat of these animals are typically structured. Additionally, the life cycles of wolves and lynxes were discussed with the help of specifically designed information cards, illuminating sexual behavior, birth and social system. To counteract possible prejudices, the animals' distribution 800 years ago and today were also of interest and explained with specific maps. Reasons for this change were discussed together with the outdoor educators. Afterwards, the students imitated the family life of the wolf and the hunting techniques of the lynx in simulation role games.

Associations given for each stimulus word at all three measurement points were iteratively categorized by following the method of inductive category development (Mayring, 2004). Three levels of category systems were obtained. At the first level, all word associations were condensed to 176 categories for the stimulus word *wolf* and 194 categories for the stimulus word *lynx*. For the second level, 52 categories and for the third level 24 categories were obtained for the stimulus word wolf, as well as 53 and 26 categories for the stimulus word lynx, respectively. Level three was used for the overall statistical calculations. Level one was applied for calculations in more detail.

All statistical analyses were calculated with IBM SPSS Statistics 21. To assess the objectivity of the categorization, Cohen's coefficient Kappa of intra- and inter-rater reliability of about 12 % of the three category levels were calculated (Cohen, 1968). Since the within-time data were found to be non-normally distributed ($p < .05$), comparisons of

the categories over the three measurement points were analyzed using the non-parametric omnibus Friedman test. For further analysis only categories with significant differences (Friedman test) were calculated with the Wilcoxon test to identify significant differences in between measurement points. For analyzing a possible weighting of negative anthropocentric or ecologic answers given on a specific position (one to six) within a stimulus word we calculated the corrected coefficient of contingency over the three measurement points. We set a threshold of $c > .2$ indicating a connection between the category and the position of the answer.

Results

Overall, 4839 (T0 = 1646, T1 = 1589, T2 = 1604) associations were collected for the stimulus word *wolf* and 4725 (T0 = 1501, T1 = 1653, T2 = 1571) associations for the stimulus word *lynx*.

For all category levels, substantial or perfect degrees of objectivity were reached by intra- and inter-rater reliability (Table 1).

Table 1 about here

Comparisons of the level-3 categories over all three measurement points yielded significant differences. In detail, for the stimulus word *wolf*, significant differences were found for 14 categories (*negative anthropocentric, negative traits of wolf, perception of the wolf* (in human terms, e.g., intelligent or ugly), *links* (e.g., histories) *to the wolf, impact of humans on the wolf, fur, body, occurrence, habitat, animal-like characteristics, social system, predation, systematically classification, evidences of wolf*). For the stimulus word *lynx*, significant differences appeared in 10 categories (*negative anthropocentric, impact of humans on the wolf, animal-like characteristics, habitat, predation, activity rhythm, fur, nutrition, social system, systematically classification*). Of these level-3 categories, only

those discussed during the education program and additionally playing an important role in the topic reintroduction, were further analyzed (Table 2). Results of the comparison of all three measurement points are displayed in figure 1.

Table 2 about here

For the stimulus word *wolf*, the following differences occurred over time (Figure 1a, Table 3a).

Table 3 about here

For the stimulus word *lynx*, the following differences were found (Figure 1b, Table 3b)

Figure 1 about here

Analyses of possibly weighted categories *negative anthropocentric* or *ecological* (all other categories than *negative anthropocentric* of Figure 1) over the three measurement points yielded a coefficient of contingency under the defined threshold of c > .2 (stimulus word *wolf*: c = .191(with c_{max} = *1.0, n = 311, p* > .001); stimulus word *lynx*: c = .108, (with $c_{\max}$ = 1.0, n = 311, p < .001).

Within the stimulus word *wolf*, two level-3 categories (occurrence and social system) and within the stimulus word *lynx* one level-3 category (*social system*) were of interest, since alternative conceptions seem to appear within these categories at level-1. To analyze change in these alternative conceptions after participation at the program, comparisons of the corresponding level-1 categories over time were calculated (Figure 2).

Figure 2 about here

Stimulus word *wolf* (Figure 2a, Table 4a, b): For the level-3 category *occurrence* the subcategories *occurrence* (*number, many*), *occurrence* (*number, few*) and *distribution* were condensed to *occurrence*, *dead* and *conservation statu*s were summarized in

conservation status and *region* still stand by oneself. For the level-3 category *social system*, the subcategories *misfit* and *loner* were grouped to *loner*, *pack* consisted of the subcategories, *alpha*, *omega*, *pack* and *ranking*, whereas *family* was condensed out of the subcategories *wolf family*, *offspring* and *family*.

Table 4 about here

Stimulus word *lynx* (Figure 2b, Table 4c): Within the level-3 category *social system*, the subcategory *loner*, which stands by itself, and the subcategory *pack* consisting of the subcategories *pack* and *alpha*, were analyzed.

Discussion

The students' task was to list the first six words coming to their mind for each stimulus word. Listing might lead a student to mention most important associations first. Most interesting in this case was, if there are predominantly students with weighted negative anthropocentric or ecological views. However, within the analysis no connection between the preferred category and the listed position was found over the three measurement points. This indicates that the students did not weight their associations in listing a preferred category first.

Categorization of the associations obtained revealed a complex pattern: 14 different categories for the stimulus word *wolf* and 10 different categories for the stimulus word *lynx*, which significantly differed over time. Additionally, as expected, frequencies within the categories shifted significantly over time, indicating the efficiency of short-term educational programs (Sellmann & Bogner, 2013).

Within these categories very different thematically fields were identified, showing the wide range of associations among young students. Almost every natural history domain, like appearance, habitats, lifestyle or even characteristics seen from human

(anthropocentric) and animal points of view were mentioned. The list of these many diverse domains shows that an associational framework about these animals seems more complex than those measured by closed questionnaires. Additionally, the method of word associations might better gather emotional links regarding these animals, too (Szalay & Deese, 1978). Those are known to play a relevant role in establishing attitudes and influencing knowledge (Bath & Farmer, 2000; Pekrun, 1992). Nevertheless, only categories regarding our educational program contents including the issue of reintroduction were of further interest and analyzed in more detail. For the stimulus word *wolf* the following categories were selected: *negative anthropocentric*, *predation*, *animal-like characteristics*, *occurrence* and *social system*, for the stimulus word *lynx* the categories *negative anthropocentric*, *predation*, *habitat*, *animal-like characteristics* and *social system* were of interest. Obviously all these categories indicated a significant improvement in associations yielded.

For both stimuli words *wolf* and *lynx*, many associations originated in the category *negative anthropocentric*. In both cases, the number of associations was significantly higher before the educational program started (T0). Especially the *wolf* was characterized as biting, aggressive or even dangerous or lethal for humans, all of them reflecting the typical picture of the wolf in histories, myths or media. In the 18th and 19th centuries, wolves in Germany were systematically eradicated due to livestock depredation or competition with game; social attitudes such as fear and dislike prevailed (Breitenmoser, 1998), resulting in an evil image (Zimen, 2003). Additionally, the media often represented incidents with wolves in misleading ways, by dramatizing and stigmatizing these animals (Houston, Bruskotter, & Fan, 2010). Although some studies promised a move towards more positive attitudes (Bath & Farmer, 2000; Hermann & Menzel, 2013), our perception data still pointed to mainly negative preferences. Our age group (10 and 11 years) apparently still follows all the myths in the context of the negative image of the wolves.

This might reflect common attitudes of young students not living in a wolf area, indicating more educational work beyond this region. However, this result could also be influenced – as figured out in other studies (Bjerke, Reitan, & Kellert, 1998; Ericsson & Heberlein, 2003; Kleiven, Bjerke, & Kaltenborn, 2004; Liukkonen, Mykrä, Bisi, & Kurki, 2009) – by some socio-demographic background. Since most of the participating schools were located in small towns the strong traditions of agriculture and hunting in these rural regions could have lead to this result.

Similarly, associations such as the *negative anthropocentric* of *lynx* exist although with lower degree than for the *wolf*. This sees the *lynx* also as a dangerous carnivore, although not as dangerous as the wolf. Nevertheless, the lynx was eradicated during the 19. century (Breitenmoser, 1998; Linnell, Swenson, & Andersen, 2001). Again, the reasons were fear of game competition, livestock attacks, but also because of the fur and bounty awards for killing the lynx. In contrast to the wolf, the lynx was not considered as dangerous to humans (Breitenmoser, 1998). Today lynxes returned either by resettling in the 1970s and 1980s or by re-establishing (Liukkonen, Mykrä, Bisi, & Kurki, 2009; Wölfl et al., 2001). Here, lynx conservation was often accompanied by conflicts and management controversies in some European countries (e.g., Kleiven, Bjerke, & Kaltenborn, 2004; Liukkonen, Mykrä, Bisi, & Kurki, 2009). Due to inadequate policy strategies especially hunters or people living in lynx areas showed more negative attitudes towards these animals (Kleiven, Bjerke, & Kaltenborn, 2004; Liukkonen, Mykrä, Bisi, & Kurki, 2009). In contrast, lynx reintroduction in Germany always was attended by positive media reports and official associations. However, in contrast to the wolf, attitudes towards the lynx among children and adolescents have not been studied, so far. The results of our study show that some young students are afraid of lynx, too. This might result from the fact that young students know that lynx belong to the big cats and associate it with lions or tigers.

Participation in our educational program clearly intervened in the associations of *wolf* and *lynx*. For instance, associations about *negative anthropocentric* dropped significantly and for long-term. The live observation of these animals and the simultaneous discussion with the outdoor educators fascinated, and provided a completely different image of the animals, no longer in an aggressive and dangerous context, but as difficult to localize in an natural environment. Students experienced these animals first of all as shy and noise-sensitive. However, these results in general point to a need to include such issues in regular syllabi (even outside authentic outdoor experiences). Especially in the light of the current re-introduction, such a sensitization will lay a good foundation for get together – and avoid repeating historic clashes. This more difficult to guarantee today due to the increase in population densities which is consuming more and more appropriate biotopes for these species (see below).

Furthermore, *predation* was associated with both stimuli words (*wolf* and *lynx)*. This category included all hunting behaviors like *stalking*, *attacking*, *biting* or *killing* and also covering up by *camouflage*. While at T0 just a small number of associations included predation showing just a few young students aware of these issues, our result should be interpreted with caution, since lynxes and wolves behave differently when hunting. Typically, only the lynx stalking as close as possible to potential prey before attacking (Pedersen, Linnell, Andersen, Andrén, & Segerström, 1999). Wolves, in contrast, hunt preferably in packs and chase their prey sometimes to its exhaustion (Zimen, 2003). We did not analyze the predation category in detail, but we assume that possible alternative associations were only named before programme participation (at T0). Afterwards, predation perceptions increased significantly for both species, indicating a learning effect through the program. Even four to six weeks later, this knowledge persists, emphasizing a thorough effect of our structured program. The hunting behavior imitation as a role game was especially effective. Through that game, it became even more obvious that hunting is a

difficult behavior, which needs practice for successful completion. Additionally, the memory of such emotional games may be retained to adulthood and makes it possible for students to understand and explain why livestock is an easy prey for these carnivores (Sebba, 1991).

Moreover, the category *habitat* produced a significant long-term increase for the stimulus word *lynx*. At T0, about one third of our sample mentioned structures like *plants*, *stones* or *forest* as *habitats* or part of *habitats* of the *lynx*. Although the program highlighted the enclosure's natural structures and discussed the desperate needs for habitats, an increase within the *habitat* category was expected. However, it did not occur in T1. We assume that right after the program week, other new and more complicated issues were present to the young participants, in contrast to the typical and simple structures of the forest and therefore of the lynx habitat. However, five to six weeks later, when the new knowledge influx may have been successfully established, a highly significant increase at T2 appeared.

For both *wolf* and *lynx*, the category *animal-like characteristics* appeared very often before the educational program started. At T1, immediately after the program, significantly more associations were made, none however persistently: Four to six weeks later, this increase had vanished. Associations like sharp ear, good vision, endurance or fearful, typically characterized the animals' behavior or physical properties. Other studies analyzing the knowledge and attitudes of large carnivores pointed to general knowledge issues like the status of the animals or the naming of endangered species and reported only poor knowledge levels (Bath & Farmer, 2000; Hermann & Menzel, 2013; Kellert, 1985). However, the highest knowledge scores among our participants appeared within the *animal-like characteristics* category, which could be compared with some biological background of the animals. The students seem to know more about typical animal traits,

whereas aspects like the status of the species apparently seem to be especially difficult to recognize, at least for younger students. In contrast, the conservation status of endangered species is probably insufficiently taught in biological lessons.

The category *occurrence* within the stimulus word *wolf* scored low, but it was still interesting, since some associations seem to represent alternative conceptions at first appearance. Therefore, this category was analyzed in more detail, by splitting into the subcategories: *region*, *occurrence* and *conservation status*. The subcategory *region* comprises natural areas, where wolves might get chances to live again. Before the program started, none of the students mentioned any region. However, the program included presenting a distribution map over Europe 800 years ago and today, and following the program students were aware of the species' excessive eradication history. Since only two regions were mentioned, the difficulty of young students to sufficiently remember regions of Germany is apparent (although this knowledge is syllabus knowledge; Catling, 1979; Schmeinck, 2009). The three regions named were *Saxony*, *Bavaria* and the *Bavarian Forest*. Since the students were asked to write down associations they have with the wolf, they simply link the word wolf with Bavaria or the Bavarian Forest, because they remember observing the wolves in the National Parks animal ground. Additionally, within the subcategory *occurrence*, which included fewer associations, only one association was mentioned regarding the general occurrence and distribution of the wolf at T0. After the program the association number increased, but still remained low, also four to six weeks later. This again supports our assumption that young students have difficulties in imagining frequencies of animals distributed in several areas.

Associations regarding the *conservation status* of the *wolf* were also mentioned rarely. However, this knowledge focused on the conservation status by citing associations such as *critically endangered*, *endangered* or even *extinct* or rather *dead*. This is conform

with the results of earlier studies showing that children are often unable to name endangered species, especially local endangered animals (e.g., Hermann & Menzel, 2013; Lindemann-Matthies, 2005; Kellert, 1985). However, the program participation substantially increased associations regarding the conservation status. This indicates that discussions with the outdoor educators about wolf eradication including the relevant distribution maps support an understanding of the (past and current) status of the wolf. Nevertheless, this topic seems more complicated, since the knowledge increase of the conservation status persisted only short-term. Five weeks later, only a few students mentioned the *conservation status*. This may also explain why it is in general difficult for young students to understand and name endangered species. Additionally, these results indicate that especially young students need better information at school about the IUCN red list and specially the endangered local species.

Another category with a large number of associations was the *social system* of both animals. Nevertheless, both species represent different social systems: Wolves belong to the canids (which live in packs, a dominant pair and its offspring of the last two years), lynxes, in contrast, prefer a solitary existence (where bonding between mother and offspring is only brief; Kleiman & Eisenberg, 1973). Both social systems were discussed in detail by using an information card, which explains in simple terms the annual circle of both animals. Additionally, the already mentioned role games consolidated the different systems, which also play an important role in the hunting behavior of both animals. To analyze in depth the understanding of these systems, we split this category into the subcategories *loner*, *pack* and *family* (*family* only within the stimulus word *wolf*). First of all, it became obvious that the frequency of the whole category *social system* was higher for the *wolf* at T0. This may result from the fact that wolves as relatives of our domestic dog with much more common myths are more familiar to young students (Bath & Farmer,

2000). A detailed look at the allocation of being a social or solitary animal showed only a few students sorting both animals incorrectly. However, right after the program, the correct allocation into the right social system significantly increased for both animals and was retained for up to six weeks. This increase again indicates that a few false preconceptions could easily be overcome with a hands-on structured program and should therefore be implemented more often within the curriculum.

Summarizing the results of our study, higher association frequencies about *wolf* and *lynx* are detectable by using our implicit method. Additionally, it allows a first impression of the wide range of association fields which students may possess about species. Nevertheless, when using the word association method as a quantitative method as we did in our study, precaution is needed: For instance, our participants exclusively came from the local region around the Bavarian forest; additionally, the number of associations students were asked to cite was limited. Nonetheless, with this method subjective perceptions and affective reactions toward wolf and lynx may become visible, for instance, in uncovering knowledge gaps within the basic understanding of both local species. Although, there are inconsistent results and discussions about the influence of attitudes and behavior on ones' knowledge and vice versa (e.g., Duerden & Witt 2010; Kollmuss & Aygeman, 2002,) through our hands-on structured program with direct experiences at the animal ground and intense discussions with the outdoor educators apparently the associations became influenced even in the long-term. This is consistent with other studies achieving long-term knowledge retention (Bogner, 1998; Fančovičová & Prokop, 2011; Sellmann & Bogner, 2013). Additionally, Bath and Farmer (2000) found that the more knowledge students bring along, the more positive are the attitudes towards these animals. However, studies of Kaczensky (2006) and Hunziker, Hoffmann, and Wild-Eck (2001) found no impact of knowledge on attitudes towards wildlife by adults. According to Kellert (1985) students from the 2nd to the 5th grade significantly increased more the emotional concern for

animals. Therefore, attitudes towards the wolf and lynx also need shifting towards the positive. This might have become visible within the category *negative anthropocentric*, where significant drops throughout our program reflected an affective perception change. Nevertheless, the very old conflict between humans and these animals still seems to have an influence also on the students associations. Therefore, discussing the animals' history in context with the human needs should become an important message in environmental education and outreach campaigns for conservation to understand the conflict situation regarding the two species.

Additionally, German curricula need to devote more attention to species threatened by our lifestyles and our high population densities, since in the long-term survival biotopes of sufficient sizes are indispensable. Future generations not only need to shift attitudes about species such as wolves and lynxes, acknowledging their existence and value for ecosystems; but they also need to set aside sufficient natural space for living, space that needs withdrawal from our current utilization; this move consequently needs to welcome demographic changes (instead of demonizing them) which may help to ease our current pressures on ecosystems.

References

Bath, A. J., & Farmer, L. (2000). *Europe's carnivores - a survey of children's attitudes towards wolves, bears and otters.* Godalming, United Kingdom: World Wildlife Found.

Bjerke, T., Ødegårdstuen, T. S., & Kaltenborn, B. P. (1998). Attitudes toward animals among Norwegian children and adolescents: Species preferences. *Anthrozoös, 11*, 227–235.

Bjerke, T., Reitan, O., & Kellert, S. R. (1998). Attitudes toward wolves in southeastern Norway. *Society & Natural Resources, 11*, 169–178.

Bogner, F. X. (1998). The influence of short-term outdoor ecology education on long-term variables of environmental perspective. *The Journal of Environmental Education, 29*, 17–29.

Breitenmoser, U. (1998). Large predators in the alps: The fall and rise of man's competitors. *Biological Conversation*, *63*, 279–289.

Bundesamt für Naturschutz (BfN, 2014). *Luchsverbreitung in Deutschland im Monitoringjahr 2013 (01.05.2013 – 30.04.2014).*

Catling, S. J. (1979). Maps and cognitive maps: The young child's perception. *Geography, 64*, 288–296.

Cohen, J. (1968). Weighted Kappa: Nominal scale agreement with provision for scaled disagrement or partial credit. *Psychological Bulletin, 70*, 213–220.

Duerden, M. D., & Witt, P. A. (2010). The impact of direct and indirect experiences on the development of environmental knowledge, attitudes, and behavior. *Journal of Environmental Psychology*, *30*, 379–392.

Ericsson, G., & Heberlein, T. A. (2003). Attitudes of hunters, locals, and the general public in Sweden now that the wolves are back. *Biological Conversation, 111*, 149–159.

Fančovičová, J., & Prokop, P. (2011). Plants have a chance: outdoor educational programmes alter students' knowledge and attitudes towards plants. *Environmental Education Research, 17*, 537–551.

Hermann, N., & Menzel, S. (2013). Threat perception and attitudes of adolescents towards re-introduced wild animals: A qualitative study of young learners from affected regions in Germany. *International Journal of Science Education, 35*, 3062–3094.

Houston, M. J., Bruskotter, J. T., & Fan, D. (2010). Attitudes towards wolves in the US and Canada: A content analysis of the print news media, 1999-2008. *Human Dimensions of Wildlife, 15*, 389–403.

Hovardas, T., & Korfiatis, K. J. (2012). Adolescents' beliefs about the wolf: Investigating the potential of human-wolf coexistence in the European South. *Society and Naturals Resources, 25,* 1277-1292.

Hunziker, M., Hoffmann, C. W., & Wild-Eck, S. (2001). Die Akzeptanz von Wolf, Luchs und «Stadtfuchs» – Ergebnisse einer gesamtschweizerisch-repräsentativen Umfrage. *Forest Snow Landscape Research,76,* 301-326.Johansson, M., & Karlsson, J. (2011).

Subjective experience of fear and the cognitive interpretation of large carnivores. *Human Dimensions of Wildlife, 16,* 15–29.

Kaczensky, P. (2006*). Werkvertrag "Medienpräsenz- und Akzeptanzstudie ‚Wölfe in Deutschland'"*. Arbeitsbereich Wildtierökologie und Wildtiermanagement, Forstzoologisches Institut, Fakultät für Forst- und Umweltwissenschaften, Universität Freiburg, Deutschland.

Kellert, S. R. (1985). Attitudes toward animals: Age-related development among children. *Journal of Environmental Education, 16,* 29-39.

Kellert, S. R. (1993). Attitudes, knowledge, and behavior toward wildlife among the industrial superpowers: United States, Japan, and Germany. *Journal of Social Issues, 49,* 53–69.

Kellert, S. R. (1997). *Kinship to mastery: Biophilia in human evolution and development*. Washington, DC: Island Press.

Kleiman, D. G., & Eisenberg, J. F. (1973). Comparisons of canid and felid social systems from an evolutionary perspective. *Animal Behaviour, 21,* 637–659.

Kleiven, J., Bjerke, T., & Kaltenborn, B. P. (2004). Factors influencing the social acceptability of large carnivore behaviours. *Biodiversity and Conversation, 13*, 1647–1658.

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research, 8,* 239–260.

Kramer, S., Revilla, E., & Wiegand, T. (2005). Lynx reintroductions in fragmented landscapes of Germany: Projects with a future or misunderstood wildlife conservation? *Biological Conversation, 125,* 169-182.

Lindemann-Matthies, P. (2005). 'Loveable' mammals and 'lifeless' plants: How children's interest in common local organisms can be enhanced through observation of nature. *International Journal of Science Education, 27*, 655–677.

Linnell, J. D. C., Swenson, J. E., & Andersen, R. (2001). Predators and people: conservation of large carnivores is possible at high human densities if management policy is favourable. *Animal Conversation, 4,* 345–349.

Liukkonen, T., Mykrä, S., Bisi, J., & Kurki, S. (2009). Conflicts and compromises in Lynx conservation and management in Finland. *Wildlife Biology, 15,* 165–174.

Mayring, P. (2004). Qualitative content analysis. In U. Flick, E. von Kardorff, & I. Steinke (Eds.). *A companion to qualitative research* (pp. 266–269). London, United Kingdom: SAGE Publications.

Müller, J., Wölfl, M., Wölfl, S., Müller, D. W. H., Hothorn, T., & Heurich, M. (2014). Protected areas shape the spatial distribution of a European lynx population more than 20 years after reintroduction. *Biological Conversation, 177*, 201–217.

Pedersen,V. A., Linnell, J. D. C., Andersen, R., Andrén, H., & Segerström, P. (1999). Lynx predation on semi-domestic reindeer. *Wildlife Biology, 5*, 203–211.

Pekrun, R. (1992). The impact of emotions on learning and achievement: Towards a theory of cognitive/motivational mediators. *Applied Psychology, 41*, 359–376.

Reinhardt, I., Kluth, G., Nowak, S. & Mysłajek, R. W. (2013). *A review of wolf management in Poland and Germany with recommendations for future transboundary collaboration*. Bonn, Germany: Bundesamt für Naturschutz.

Rosenfeld, R. A. (1978). Anxiety and learning. *Teaching Sociology, 5*, 151–166.

Scarce, R. (1998). What do wolves mean? Conflicting social constructions of Canis lupus in "bordertown". *Human Dimensions of Wildlife, 3*, 26–45.

Schmeinck, D. (2009). Up to the garden fence or the world at primary school. *Orbis Scholae, 3*, 77–95.

Sebba, R. (1991). The landscapes of childhood: The reflection of childhood's environment in adult memories and in children's attitudes. *Environment and Behavior, 23*, 395–422.

Sellmann, D., & Bogner, F. X. (2013). Climate change education: quantitatively assessing the impact of a botanical garden as an informal learning environment. *Environmental Education Research, 19*, 415–429.

Szalay, L. B., & Deese, J. (1978). *Subject meaning and culture. An assessment theory word associations.* Hillsdale: Erlbaum Publication.

Wölfl, S. (2012). *Projekt zur Umsetzung des Luchs-Managementplans "Luchse in Bayern" – Projektbericht, Zeitraum März 2010 – Juli 2012.*

Wölfl, M., Bufka, L., Červený, J., Koubek, P., Heurich, M., Habel, H., … Poost, W. (2001). Distribution and status of lynx in the border region between Czech Republic, Germany and Austria. *Acta Theriologica, 46*, 181-194.

Zimen, E. (2003). *Der Wolf - Verhalten, Ökologie und Mythos*. Stuttgart, Germany: Kosmos.

Tables

Table 1: Intra- and Inter-rater agreement of the three category levels (Level-1 to -3 indicate the different stages of categorization)

Category-Level	Stimulus-word	Intra-rater agreement	Inter-rater agreement
Level-1	wolf	.80	.75
	lynx	.92	.73
Level-2	wolf	.97	.75
	lynx	.86	.73
Level-3	wolf	.73	.82
	lynx	1.00	.72

Table 2: Level-2 and -3 categories of analysis with student examples

A: Wolf

Level-3 categories	Level-2 categories	students example
negative anthropocentric	dangerous	danger
	biting	biting
	aggressivity	aggressive
occurrence	occurrence (number, many)	many
	occurrence (number, few)	few
	distribution	distribute
	dead	dead
	conservation status	critically endangered
	region	Bavaria
animal-like characteristics	timid	timid
	fearful	be afraid of humans
	curiosity	curious
	high speed	fast
	endurance	long-distance runner
	strong	strong
	wild	wild
	skill	clever
	noisy	noisy
	quiet	quiet
	sensory input	noise
	good sense of smell	scents
	sharp ear	hears
	good vision	sees good
	rabies	rabies
social system	misfit	misfit
	loner	loner
	alpha	leader
	omega	omega
	pack	wolf pack
	ranking	ranking

	wolf family	wolf father
	offspring	cub
	family	extended family
predation	bits	bits
	attacks	attacks
	stalks	stalks
	foraging	cares for food
	kills	mauls
	hunting	hunts
	hides	hides
	crypsis	camouflage

B: Lynx

Level-3 categories	Level-2 categories	students example
negative anthropocentric	dangerous	dangerous
	biting	biting
	aggressiveness	aggressive
	lethal	lethal
animal-like characteristics	timid	timid
	tame	trusting
	fearful	be afraid of humans
	flexible	flexible
	curiosity	curious
	high speed	fast
	endurance	persistent
	slowly	slowly
	no endurance	no long-distance runner
	strong	strong
	skill	clever
	noisy	noisy
	silent	silent
	wild	wild
	poor vision	cannot see well
	good vision	sees good

	sharp ear	hears
	good sense of smell	scents
habitat	nature	nature
	wilderness	wilderness
	landscape	landscape
	territory	territory
	outdoor	outside
	freedom	free
	snow	snow
	forest	forest
	tree	tree
	forest plants	many bushes
	habitats	clearing
	stone	stone
	physical Parameter	light
	cave	caves
	natural habitation	shelter
predation	hunting	hunting
	attacks	attacks
	stalks	stalks
	bits	bits
	crypsis	camouflage
	hiding	hides
social system	lynx family	lynx mother
	offspring	cub
	family	family
	male	male
	female	female
	loner	no pack
	pack	pack
	alpha animal	lynx leader

Note: The word “lethal” was classified to the category “negative anthropocentric” due to the context of the other given association of these participants. However, notify that the student with “lethal” could also have interpreted “lethal for humans” instead of “lethal for prey”.

Table 3: Comparison of the three measurement points of level-3 categories

a) Wolf

category	**mean ± SE (T0)**	**mean ± SE (T1)**	**mean ± SE (T2)**	***p* (T0 – T1)**	***p* (T0 – T2)**	***p* (T1 - T2)**
neg. anthropocentric	.44 ± .03	.44 ± .03	.25 ± .03	≤ .001	≤ .001	n.s.
predation	.18 ± .03,	.30 ± .03	.27 ± .03	.001	≤ .01	n.s.
animal-like characteristics	.58 ±.05	.73 ± .05	.54 ± .04	≤ .01	n.s.	≤ .001
occurrence	.04 ± .01	.09 ± .02	.05 ± .01	.009	n.s.	≤ .05
social system	.32 ± .04	.77 ± .05	.64 ± .04	≤ .001	≤ .001	≤ .05

b) Lynx

category	**mean ± SE (T0)**	**mean ± SE (T1)**	**mean ± SE (T2)**	***p* (T0 – T1)**	***p* (T0 – T2)**	***p* (T1 - T2)**
neg. anthropocentric	.25 ± .03	.17 ± .02	.15 ± .02	≤ .05	.001	n.s.
predation	.19 ± .03	.34 ± .03	.28 ± .03	≤ .001	.001	n.s.
animal-like characteristics	.78 ± .05	.96 ± .06	.71 ± .05	≤ .05	n.s.	.001
habitat	.28 ± .04	.44 ± .04	.56 ± .05	n.s.	≤ .001	≤ .05
social system	.12 ± .03	.27 ± .03	.30 ± .03	≤ .001	≤.001	n.s.

Table 4: Comparison of the three measurement points of level-1 categories

a) wolf (level-3 category occurrence)

category	**mean ± SE (T0)**	**mean ± SE (T1)**	**mean ± SE (T2)**	***p* (T0 – T1)**	***p* (T0 – T2)**	***p* (T1 - T2)**
occurrence	.003 ± .003	.01 ± .006	.01 ± .006	n.s.	n.s.	n.s.
Conservation status	.04 ± .01	.07 ± .02	.04 ± .01	≤ .05	n.s.	≤ .05
region	0 ± 0	.003 ± .003	.01 ± .005	n.s.	n.s.	n.s.

b) wolf (level-3 category social system)

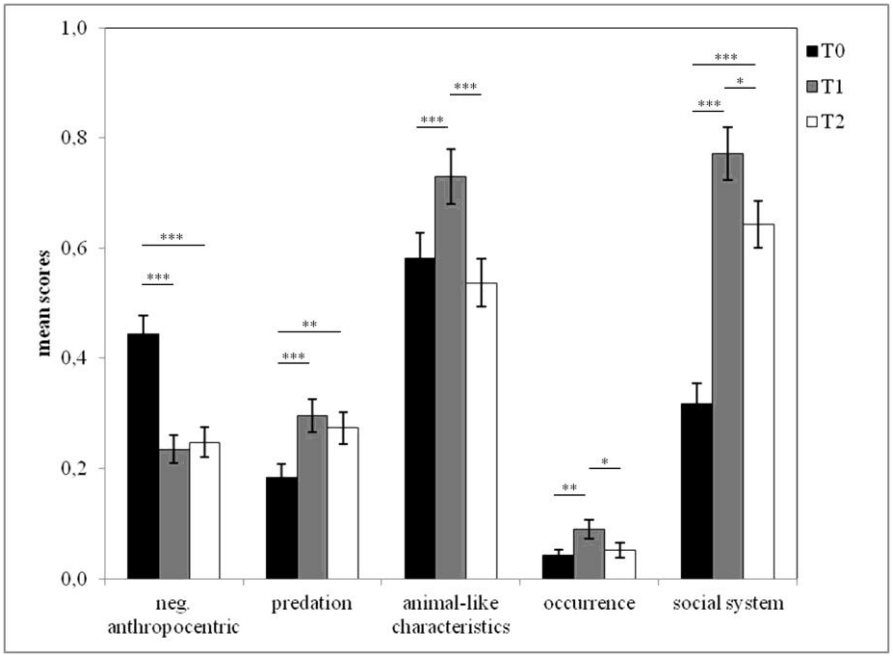
category	**mean ± SE (T0)**	**mean ± SE (T1)**	**mean ± SE (T2)**	***p* (T0 – T1)**	***p* (T0 – T2)**	***p* (T1 - T2)**
loner	0 ± 0	.01 ± .005	.01 ± .005	n.s.	n.s.	n.s.
pack	.25 ± .03	.65 ± .04	.55 ± .04	≤ .001	≤ .001	≤ .05
family	.07 ± .02	.11 ± .03	.09 ± .02	≤ .05	n.s.0	n.s.

c) lynx (level-3 category social system)

category	**mean ± SE (T0)**	**mean ± SE (T1)**	**mean ± SE (T2)**	***p* (T0 – T1)**	***p* (T0 – T2)**	***p* (T1 - T2)**
loner	.04 ± .01	.18 ± .02	.21 ± .02	≤ .001	≤ .001	n.s.
pack	.02 ± .01	.02 ± .01	.01 ±01	n.s.	n.s.	n.s.

Figures

a) wolf



b) lynx

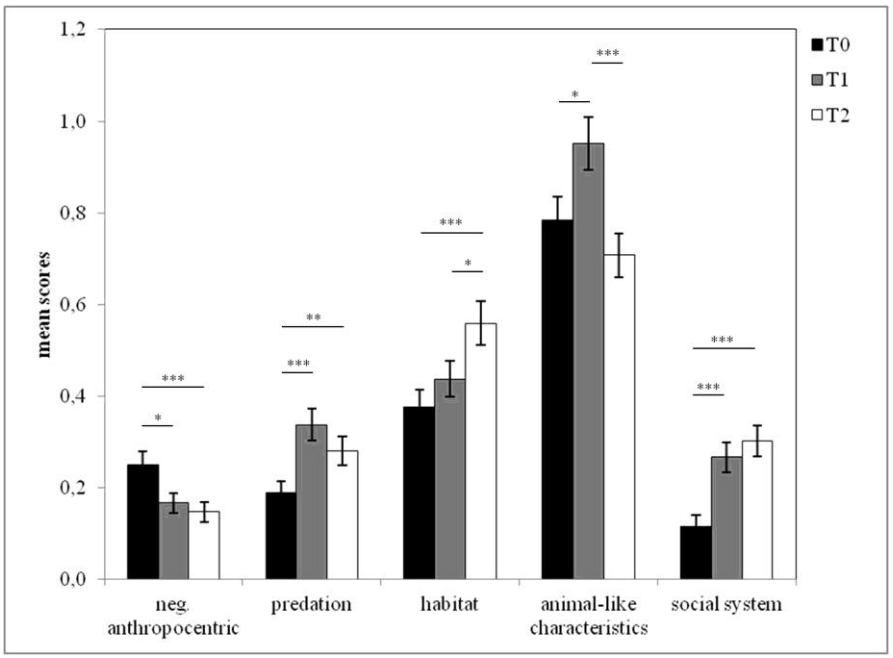
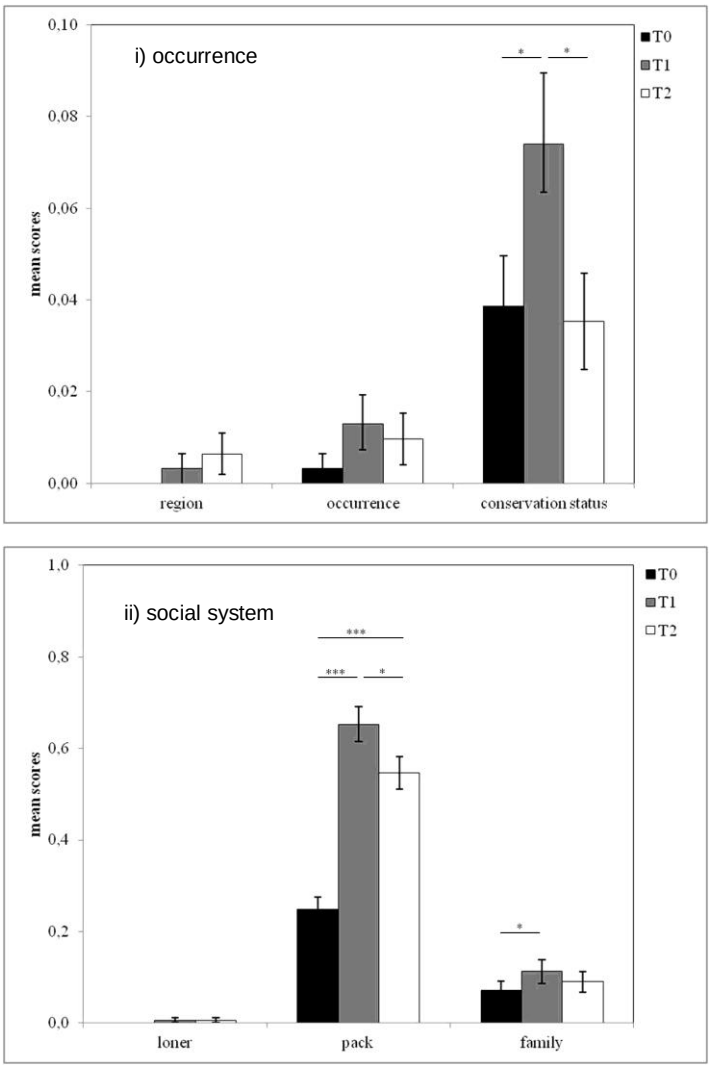


Figure 1: Association frequencies (mean scores ± SE per student) of selected level-3 categories of a) wolf and b) lynx at the three measurement points. Note: *: $p \leq .05$, **: $p \leq .01$, ***: $p \leq .001$.

Figure 2
a) wolf



b) lnyx

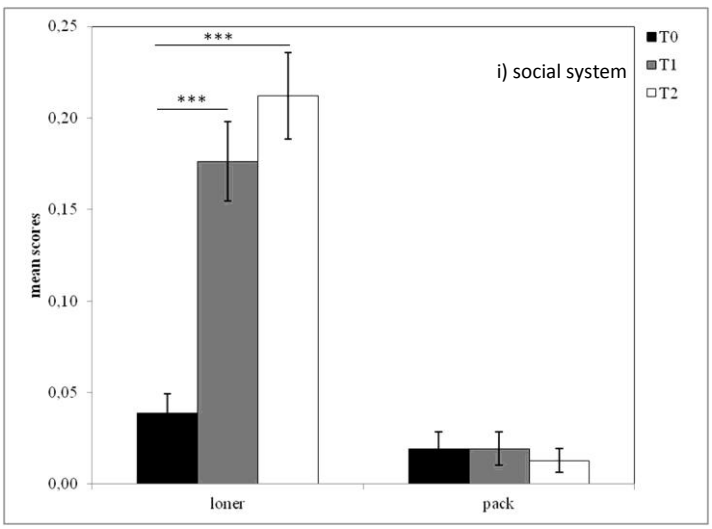


Figure 2: Association frequencies (mean scores ± SE per student) of selected subcategories of level-3 categories of a) wolf and b) lynx at the three measurement points. Note: *: $p \leq .05$, **: $p \leq .01$, ***: $p \leq .001$.

Anhang

Im Folgenden ist der Fragebogen wie er im Nachtest verwendet wurde dargestellt. Der Teil F) und G) wurde nur im Nachtest abgefragt. Die Reihenfolge der Items und Antwortmöglichkeit der anderen Skalen (Teil A) bis E)) wurden für jeden Test zufällig mit *R* berechnet.

Die erstellten und verwendeten Unterrichtsmaterialen werden auf Grund von Urheberrechten in einem gesondert gedruckten Anhang dargestellt.

Fragebogen (Nachtest)

UNIVERSITÄT BAYREUTH

Nationalpark Bayerischer Wald

Fragebogen zum Umweltbildungsprojekt

Entdeckungsreise durch den Nationalpark Bayerischer Wald

Liebe Schülerin, lieber Schüler,

Datum: .....

vielen Dank, dass Du an dieser Befragung teilnimmst!

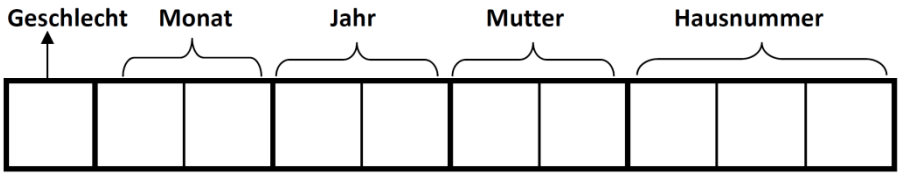
Dieser Fragebogen ist Teil einer wissenschaftlichen Untersuchung und streng vertraulich. Er wird **nicht** von Deiner Lehrkraft benotet.

- Bearbeite den Test bitte **alleine** und **sorgfältig**.
- Kreuze die Antwort an, die **Deiner Meinung nach** richtig ist.
- Wenn Du Dich beim Ankreuzen vertan hast, dann male das Kästchen vollständig aus und kreuze ein anderes an.
- Wenn Du fertig bist: Kontrolliere bitte, ob Du alle Seiten ausgefüllt hast!

Dein persönlicher Code:

Dein persönlicher Code besteht aus:

1. Bist du ein **Mädchen** oder ein **Junge** *(**W**eiblich oder **M**ännlich)*?
2. In welchem **Monat** hast du **Geburtstag** *(z.B. 01, 02, 03, ... , 09, 10, 11, 12)*?
3. In welchem **Jahr** hast du **Geburtstag** *(z.B. 99, 00, 01, 02, 03, 04)*?
4. Mit welchen **zwei Buchstaben** beginnt der **Name deiner Mutter**?
5. Welche **Hausnummer** habt ihr *(z.B. 001, 034, 115)*?



Bsp: Anne ist weiblich, geboren im September 2000, ihre Mutter heißt Renate und sie wohnt in Hausnummer 59.

Annes Code lautet:

W	0	9	0	0	R	E	0	5	9

Und los geht‘s!

A) Schreibe jeweils 6 Wörter auf, die dir spontan und ohne lange zu überlegen, zu den folgenden drei Wörtern einfallen.

LUCHS: _____ _____ _____

_____ _____ _____

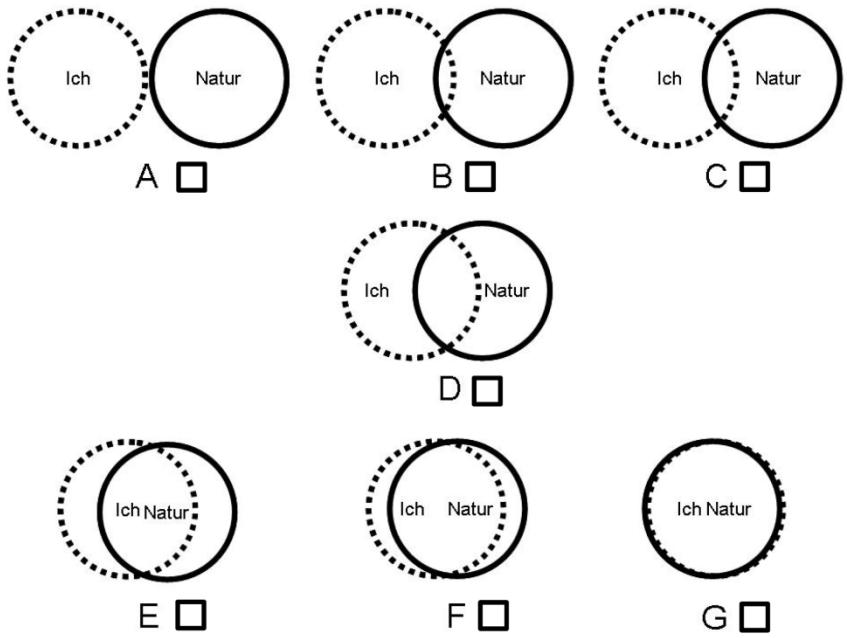
WOLF: _____ _____ _____

_____ _____ _____

WALD: _____ _____ _____

_____ _____ _____

B) Schau dir die folgenden Kreise an! Wie verbunden fühlst du dich mit der Natur?



C) Bitte bewerte die folgenden Aussagen, indem du im entsprechenden Kästchen ein Kreuz setzt.

	Folgende Aussage finde ich →	völlig richtig	ziemlich richtig	unent-schieden	ziemlich falsch	völlig falsch
1	Der Mensch wurde erschaffen, um über den Rest der Welt zu herrschen.	☐	☐	☐	☐	☐
2	Menschen sind wichtiger als andere Lebewesen.	☐	☐	☐	☐	☐
3	Umweltschutz kostet viel Geld. Ich bin bereit, bei einer Sammlung mitzuhelfen.	☐	☐	☐	☐	☐
4	Ich sitze gerne am Rand eines Weihers und beobachte dabei zum Beispiel Libellen.	☐	☐	☐	☐	☐
5	Ich versuche häufig, andere davon zu überzeugen, dass Umweltschutz wichtig ist.	☐	☐	☐	☐	☐
6	Tiere und Pflanzen existieren in erster Linie zum Nutzen der Menschen.	☐	☐	☐	☐	☐
7	Wenn ich älter bin, werde ich aktiv in einer Naturschutzgruppe mitmachen.	☐	☐	☐	☐	☐
8	Die Menschen machen sich über die Umweltverschmutzung zu viele Gedanken.	☐	☐	☐	☐	☐
9	Der Mensch braucht sich nicht der Natur anzupassen, sondern kann sie für seine Bedürfnisse ändern.	☐	☐	☐	☐	☐
10	Der Umweltschutz hält oft den Fortschritt auf.	☐	☐	☐	☐	☐
11	Ich fühle mich wohl in der Stille der Natur.	☐	☐	☐	☐	☐
12	Um Abfall in der Natur aufzusammeln, würde ich meine Freizeit opfern.	☐	☐	☐	☐	☐
13	Es macht mir großen Spaß, selbst ins Grüne (Wald, Wiese) hinauszugehen.	☐	☐	☐	☐	☐
14	Wir sollten nur nützliche Tiere und Pflanzen schützen.	☐	☐	☐	☐	☐
15	Wenn ich einmal extra Taschengeld bekomme, werde ich einen Teil davon an Umweltorganisationen spenden.	☐	☐	☐	☐	☐
16	Wir müssen Wälder abholzen, um möglichst viele Getreidefelder anzulegen.	☐	☐	☐	☐	☐

D) Bitte bewerte die folgenden Aussagen, indem du im entsprechenden Kästchen ein Kreuz setzt.

	Diese Aussage →	 stimmt genau	 stimmt	 teils, teils	 stimmt nicht	 stimmt über-haupt nicht
1	Traurige Filme über Tiere hinterlassen bei mir oft einen Kloß im Hals.	☐	☐	☐	☐	☐
2	Manchmal bin ich verwundert, wie entsetzt Menschen sind, wenn ein altes Haustier stirbt.	☐	☐	☐	☐	☐
3	Es macht mich traurig, ein Tier alleine in einem Käfig zu sehen.	☐	☐	☐	☐	☐
4	Es ist albern, wenn jemand zu sehr an seinem Haustier hängt.	☐	☐	☐	☐	☐
5	Ich würde immer versuchen zu helfen, wenn ich einen Hund oder einen Welpen sehe, der sich anscheinend verlaufen hat.	☐	☐	☐	☐	☐
6	Viele Menschen sind zu versessen auf ihre Haustiere.	☐	☐	☐	☐	☐
7	Ich werde sehr wütend, wenn ich sehe, dass Tiere schlecht behandelt werden.	☐	☐	☐	☐	☐
8	Ich finde es komisch, wenn Hunde versuchen mich zu begrüßen, indem sie hochspringen und mich ablecken.	☐	☐	☐	☐	☐
9	Haustiere haben einen großen Einfluss darauf, wie es mir geht.	☐	☐	☐	☐	☐
10	Menschen vergleichen oft die Gefühle und Empfindungen von Tieren mit denen von Menschen.	☐	☐	☐	☐	☐
11	Es bringt mich aus der Fassung, Tiere zu sehen, die Schmerzen haben.	☐	☐	☐	☐	☐

E) Beantworte die folgenden Fragen. Nur eine Antwort ist richtig!

Aus welchen Mitgliedern besteht ein **Wolfsrudel**?

- ☐ ausgewachsene, nicht verwandte Wölfe
- ☐ ausgewachsene, verwandte Wölfe
- ☐ Eltern und Jungtieren
- ☐ Jungtiere ohne Eltern

Wozu werden Grünbrücken gebaut?

- ☐ damit man im Grünen über die Straße laufen kann
- ☐ damit es mehr grüne Flächen gibt
- ☐ damit sich der Luchs besser verbreiten kann
- ☐ weil es schön aussieht

Bei welchen Bedingungen kann sich der Borkenkäfer besonders gut verbreiten?

- ☐ in einem gesunden Wald
- ☐ bei Kälte
- ☐ nach einem Sturm
- ☐ bei hoher Feuchtigkeit

Was sollte in dem Lebensraum des **Luchses** vorkommen?

- ☐ offene Flächen
- ☐ viele Straßen
- ☐ viele Felsen
- ☐ dichter Wald

Was unterscheidet einen Nadelbaum von einem Laubbaum?

- ☐ Äste
- ☐ Blattform
- ☐ Wurzeln
- ☐ Rinde

Was muss ich tun, wenn ich im Wald einem Wolf begegne?

- ☐ ihn nicht beachten
- ☐ auf ihn zugehen
- ☐ laut sein
- ☐ wegrennen

Wie wird außerhalb des Nationalparks der Borkenkäfer bekämpft?

- ☐ befallene Bäume abholzen
- ☐ gar nicht
- ☐ Bäume mit Pflanzenschutzmittel besprühen
- ☐ Bodenfallen auslegen

Was macht ein junger **Luchs**, wenn er die Mutter verlassen hat?

- ☐ sich Freunde suchen
- ☐ sich ein neues Revier suchen
- ☐ sich einen Partner suchen
- ☐ mit seinen Geschwistern umherziehen

Wie lässt sich das Revier eines Luchses vergrößern?

- ☐ Waldverbindungen zwischen Wäldern anlegen
- ☐ Felder zwischen Waldstücken anlegen
- ☐ Felshöhlen anlegen
- ☐ Mehr Versteckmöglichkeiten anbieten

Was macht das Eichhörnchen im Herbst?

- ☐ eine Höhle für die Winterruhe suchen
- ☐ eine Höhle in der Erde bauen
- ☐ Nahrungsvorrat sammeln und gut verstecken
- ☐ ein Nest für den Winter bauen

Wie können die Menschen das Motto: „Natur, Natur sein lassen“ umsetzen?

- ☐ Sie entfernen tote Bäume aus dem Wald.
- ☐ Sie helfen dem Wald beim Wachsen.
- ☐ Sie greifen nicht in die Natur ein.
- ☐ Sie überwachen den Wald.

Was bedeutet es, wenn der **Wolf** seinen Schwanz zwischen den Hinterbeinen einklemmt?

- ☐ er droht
- ☐ er hat Angst
- ☐ er unterwirft sich
- ☐ er will spielen

Wie groß und schwer wird ungefähr ein ausgewachsener **Luchs**?
☐ wie ein Wildschwein
☐ wie ein Mensch
☐ wie eine Hauskatze
☐ wie ein Schäferhund

In welchem Teil von Deutschland haben sich wieder **Wölfe** angesiedelt?
☐ Süden
☐ Norden
☐ Westen
☐ Osten

Warum wurde im Bayerischen Wald ein Nationalpark gegründet?
☐ weil dort keine Menschen gewohnt haben
☐ weil dort ein Mischwald vorhanden war
☐ weil man die Landschaft dort schützen wollte
☐ weil der Luchs dort schon damals vorkam

Wo kommt der **Luchs** in Deutschland wieder vor?
☐ an der Ostsee
☐ in Berlin
☐ in den Alpen
☐ im Nationalpark Bayerischer Wald

Welche Tiere gehören **nicht** zur Beute des **Wolfes**?
☐ Rehe
☐ Hirsche
☐ Luchse
☐ Wildschweine

Wie viele Stockwerke hat ein Wald?
☐ drei
☐ sechs
☐ vier
☐ fünf

F) Beantworte die folgende Frage.

Hast du dir die **Poster** im Aufenthaltsraum angeschaut?
☐ ja
☐ nein

Auf der nächsten Seite geht's weiter ►

G) Beantworte die folgenden Fragen. Bitte nur ein Kästchen ankreuzen!

	Diese Aussage →	 stimmt genau	 stimmt	 teils, teils	 stimmt nicht	 stimmt über-haupt nicht
1	Diese Woche war zum Einschlafen.	☐	☐	☐	☐	☐
2	Was ich über die Themen dieser Woche erfahren habe, bringt mir was.	☐	☐	☐	☐	☐
3	Ich war mit den Gedanken diese Woche öfter woanders.	☐	☐	☐	☐	☐
4	Diese Woche hat mir Freude gemacht.	☐	☐	☐	☐	☐
5	Ich möchte mehr über die Themen dieser Woche erfahren.	☐	☐	☐	☐	☐
6	Ich fand die Themen dieser Woche wichtig.	☐	☐	☐	☐	☐
7	Ich war mit dieser Woche zufrieden.	☐	☐	☐	☐	☐
8	Ich habe mich gelangweilt.	☐	☐	☐	☐	☐
9	Diese Woche hat mir Spaß gemacht.	☐	☐	☐	☐	☐

Bitte überprüfe, ob du alle Seiten ausgefüllt hast!

Vielen Dank für deine Hilfe!

Danksagung

Mein erster Dank gilt Prof. Dr. F. X. Bogner für die Gelegenheit an seinem Lehrstuhl innerhalb eines sehr interessanten Interessensgebietes zu promovieren. Darüber hinaus möchte ich mich für die Möglichkeit und Unterstützung des selbstständigen wissenschaftlichen Arbeitens und die Erweiterung meiner sozialen Kompetenzen bedanken. Die Durchführung und die Mitarbeit an Lehrveranstaltungen und dem EU-Projekt PATHWAY haben mich vor allem in meiner persönlichen Entwicklung weitergebracht.

Weiterhin möchte ich Herrn Dr. F.J. Scharfenberg für die immer offene Türe und sehr hilfreichen Diskussionen zur Statistik und didaktischen Themen danken. Ein besonderer Dank gilt Frau S. Hübner, die für jedes Problem immer eine Lösung wusste und mir jederzeit in vielen Bereichen unterstützend zur Seite stand.

Ein weiterer Dank geht an Frau R. Gaidies und das Team vom Jugendwaldheim des Nationalparks Bayerischer Wald, die zum erfolgreichen Gelingen des Unterrichtsprogrammes beigetragen haben. Danke auch für den immer wieder freundlichen Empfang, die tollen Anregungen, die detaillierte organisatorische Planung, den wirklich interessanten Austausch und vor allem die gelungene Durchführung meiner Interventionsstudie!

Außerdem möchte ich mich bei allen meinen Kolleginnen und Kollegen, die mich während meiner Promotionszeit begleitet haben für die unzähligen und hilfreichen Diskussionen und Unterhaltungen bedanken. Mein besonderer Dank gilt dabei Christine Arnold, die ich als hervorragende und immer hilfsbereite Bürokollegin und Freundin kennenlernen durfte. Danke, dass du immer für mich da warst! Auch bei Christian Fremerey möchte ich mich für vielen hilfreichen Gespräche und die ansteckende gute Laune bedanken.

Danke auch an die beiden Sekretärinnen, die bei vielen organisatorischen Fragen immer hilfreich zur Seite standen und einen Großteil der organisatorischen Notwendigkeiten abgefangen haben.

Darüber hinaus möchte ich mich bei allen Schülerinnen, Schülern, Lehrern und Betreuern bedanken, die mit viel Spaß an meiner Interventionsstudie teilgenommen haben und diese Arbeit erst möglich gemacht haben.

Zu guter Letzt möchte ich mich besonders bei meinem Mann Bernd Dieser, meiner Familie und meinen engsten Freunden bedanken, die immer an mich geglaubt und mich in den manchmal schwierigen Zeiten immer wieder aufgebaut und motiviert haben.

Herzlichen Dank an alle, die in irgendeiner Form zum Gelingen dieser Arbeit beigetragen haben!

(Eidesstattliche) Versicherungen und Erklärungen

(§ 5 Nr. 4 PromO)
Hiermit erkläre ich, dass keine Tatsachen vorliegen, die mich nach den gesetzlichen Bestimmungen über die Führung akademischer Grade zur Führung eines Doktorgrades unwürdig erscheinen lassen.

(§ 8 S. 2 Nr. 5 PromO)
Hiermit erkläre ich mich damit einverstanden, dass die elektronische Fassung meiner Dissertation unter Wahrung meiner Urheberrechte und des Datenschutzes einer gesonderten Überprüfung hinsichtlich der eigenständigen Anfertigung der Dissertation unterzogen werden kann.

(§ 8 S. 2 Nr. 7 PromO)
Hiermit erkläre ich eidesstattlich, dass ich die Dissertation selbständig verfasst und keine anderen als die von mir angegebenen Quellen und Hilfsmittel benutzt habe.

(§ 8 S. 2 Nr. 8 PromO)
Ich habe die Dissertation nicht bereits zur Erlangung eines akademischen Grades anderweitig eingereicht und habe auch nicht bereits diese oder eine gleichartige Doktorprüfung endgültig nicht bestanden.

(§ 8 S. 2 Nr. 9 PromO)
Hiermit erkläre ich, dass ich keine Hilfe von gewerbliche Promotionsberatern bzw. -vermittlern in Anspruch genommen habe und auch künftig nicht nehmen werde.

…….
Ort, Datum, Unterschrift