International Journal of Instruction *July 2009 ● Vol.2, No.2*
ISSN: 1694-609X ● www.e-iji.net

ASSOCIATION BETWEEN EMOTIONAL VARIABLES AND SCHOOL ACHIEVEMENT

Christoph Randler
Prof., University of Education Heidelberg, GERMANY
randler@ph-heidelberg.de

Recent psychological studies highlight emotional aspects, and they show an important role within individual learning processes. Hereby, positive emotions were supposed to positively influence learning and achievement processes and negative ones do the contrary. In this study, an educational unit "ecosystem lake" was used during which achievement (three tests) and emotional variables (interest, well-being, anxiety and boredom; measured at the end of three pre-selected lessons) were monitored. The research question was to explore correlations between emotional variables and the learning outcome of the teaching unit. Prior knowledge was regressed against the subsequent tests to account for its confounding effect. Regressions showed a highly significant influence of prior knowledge on the subsequent measurements of achievement. However, after accounting for prior knowledge, a positive correlation between interest/well-being and achievement and a negative correlation between anxiety/boredom and achievement was found. Further research and interventions should try to enhance positive emotions in biology lessons to positively influence achievement.

Key Words: achievement, anxiety, boredom, interest, well-being

INTRODUCTION

According to Pintrich, Marx and Boyle (1993) learning processes could not barely be defined just as „cold cognition" and additional factors such as cognitive, affective and social variables have to be taken into consideration, too. Some psychological studies emphasise the significance of emotions in both learning and performance situations. However, until recently, emotions have not been sufficiently attended to in classroom instruction in general (Gläser-Zikuda, Fuß, Laukenmann, Metz & Randler, 2005), and have been rather neglected in research in biology education. Hereby, positive emotions were supposed to

positively influence learning and achievement processes and negative ones do the contrary (Laukenmann, Bleicher, Fuß, Gläser-Zikuda, Mayring & Rhöneck, 2003; Pekrun, Götz, Titz & Perry, 2002). Such correlations between either interest or motivation and achievement scores have been previously acknowledged in some subjects, *e.g.* by Schiefele and Csikszentmihalyi (1998) and Schiefele and Rheinberg (1997), while other emotional aspects, such as anxiety, boredom or well-being have been rarely considered. Emotional factors have been investigated in a rather isolated fashion and rarely in the context of preconditions, as e.g. prior knowledge, and even more rarely in relation to subject-specific matters or a specific biological unit with its specific content.

The study presented here is based on a concept that distinguishes between current situational emotions – hereafter "state" emotions – and biographically developed and enduring "trait"- emotions (Ulich and Mayring, 1992). The idea behind this distinction may be clarified by an example using the construct 'interest': Pupils may experience a particular lesson, e.g. a hands-on lesson or a specific topic as thoroughly interesting even though they do not have a general interest in the subject biology (see Laukenmann *et al*., 2003). In the focus of this present study were the situational ("state") emotions because they could be directly linked to the content of the respective educational unit and the respective tests on achievement. The concept of "state"- variables means that they were collected immediately after the respective lessons (which is a more direct measurement compared to trait-variables).

Here, we used an educational unit "ecosystem lake" during which achievement (three tests) and emotional variables (interest, well-being, anxiety and boredom, measured at the end of three lessons) were monitored. The research question was to explore correlations between emotional variables (well-being, interest, anxiety and boredom) and the learning outcome of the teaching unit.

METHOD

Study design

The study covered >500 pupils in south-western Germany; however the analysis is based on 426 individuals that took part in all tests and questionnaires. We selected 9th graders of the medium (Realschule; N = 284) and 8th graders of the highest stratification level (Gymnasium, N = 142) due to the existing syllabus. 223 (52,3%) of our participants were girls and 203 boys [Please note that the German school system separates pupils at the end of the 4th grade into three different stratification level: high stratification (Gymnasium),

medium stratification (Realschule) and low stratification (Hauptschule)]. Altogether, our specific educational unit selected a 14 lesson unit dealing with the ecosystem "lake" (Randler & Bogner, 2008). The selection of 8th and 9th graders was because ecology is taught in the 8th grade of the highest stratification and in the 9th grade of the medium stratification. Therefore, the selection criterion of the grade was the existing syllabus, in this case ecology (Randler & Bogner, 2008). Unfortunately, in the low stratification (Hauptschule), there is no existing syllabus where ecology can be taught in this age group for 14 lessons. Therefore, this stratification could not be included in the study although it might have been an interesting aspect.

Germany has a federal system, that is, each state within this country has its own special syllabus. The pupils came from south-western Germany, Baden-Württemberg, but the results seem to be transferable well beyond the borders of Germany. Schools were selected according to their willingness to participate in the study because these schools had to apply an educational unit of 14 hours developed for ecology teaching. Therefore, the sample may be biased towards more interested and innovative principals, teachers and parents. However, I do not believe that this has an influence upon the association between achievement and emotions. Moreover, in most field studies, the collaboration of pupils, teachers and principals with researchers is necessary, so that a completely randomised procedure can – at least in most cases – not be applied.

Emotional variables

Emotional variables included four constructs: interest, well-being, anxiety and boredom (details see Gläser-Zikuda *et al*., 2005). The questionnaire consisted of 19 items based on a five-point Likert-scale (see examples of items in Table 1), i.e. each of the four constructs construct was measured with more than one item. These psychometric data were filled out by pupils immediately at the end of three pre-selected lessons. I chose to measure these situational emotions three times to receive a more precise picture and more reliable data than one measurement alone. First, the means for each construct were calculated per pupil and lesson, and then the averages from all three lessons were calculated per construct and pupil. Thus, each pupil received four measurements, one for each psychological construct. The validity and reliability of these scales were good (for details, see Gläser-Zikuda et al., 2005; Cronbach's alpha ranged from 0.78-0.92). Summing up these items does not seem to have any influence.

Table 1. Examples of the items of the state-questionnaire

Interest: The lesson was interesting for me.
Well-being: I enjoyed the lesson.
Anxiety: I felt insecure during the lesson.
Boredom: I felt bored.

Achievement variables

A battery of tests was used for achievement: i) prior to the instruction, ii) immediately after the instruction (used for grading), and iii) with a delay of 6-8 weeks (used as a retention test). Pupils were not prewarned of this retention test. The achievement tests dealt with the details of the 14 lessons (Randler and Bogner, 2008). The tests were developed from an item pool constructed with respect to the specific goals of the educational unit. Then, by an expert rating of colleagues from biology, the items were refined or discarded and pretested in a pupil sample of the same age group and stratification with half of them having received already some teaching and instruction in ecology and half of the not. Subsequently, the percentage of correct answers and the quality to differentiate between good and worse pupils were calculated to receive the final set of tests. These results from the final tests applied during the educational unit were highly correlated with the grading (marks) given by the teachers, providing some kind of external validity.

Generally, prior knowledge significantly influences learning and instruction (Fraser, Walberg, Welch & Hattie, 1987) and often, prior knowledge explained most of the variance in subsequent tests (Einsiedler & Treinies, 1997, Schiefele and Rheinberg, 1997). To account for this confounding effect of prior knowledge it was removed by a regression technique. Prior knowledge was regressed against i) the class test, and ii) against the the retention test, and iii) both prior knowledge and class test were regressed against retention test. These regressions simply revealed that pretest scores significantly influenced posttest scores. To account for this effect, the standardized residuals from these regressions were saved as new variables. The variance in these residuals of posttest and retention is now unaffected by pretest scores. Then, it can be used for further correlations with the emotional state-variables. This procedure "subtracts" the confounding effects of prior knowledge from the learning

outcome (subsequent tests) and any correlation between emotional variables and achievement are now cleaned from the simple effect of prior knowledge on subsequent achievement.

One may argue that a Likert scale may be by nature an ordinal scale, however, by definition many researchers use Likert scales in parametric testing procedure.

RESULTS AND DISCUSSION

All three regressions showed a highly significant influence of prior knowledge on the subsequent measurements of achievement. Adjusted R^2 were 0.14 (pre-test on class test), 0.15 (pre-test on retention) and 0.46 (pretest and class test on retention). This emphasises the influence of prior knowledge. However, after accounting for prior knowledge, a positive correlation between the psychological constructs interest and well-being with achievement and a negative correlation between anxiety and boredom with achievement was found (Table 2). These correlations were not confounded by prior knowledge since the regression technique accounted for this influence by using the standardised residuals.

Table 2. Correlation between achievement (residualised for prior knowledge) and emotional variables measured at the end of three selected lessons in the educational unit "ecosystem lake".

Achievement		*Interest*	*Well-being*	*Anxiety*	*Boredom*
Standardized Residual	*r*	0.178	0.207	-0.197	-0.209
Pretest/class test	*P*	<0.001	<0.001	<0.001	<0.001
	N	426	426	426	426
Standardized Residual	*r*	0.098	0.159	-0.157	-0.181
Pretest/class & retention test	*P*	0.042	=0.001	=0.001	<0.001
	N	426	426	426	426
Standardized Residual	*r*	0.186	0.252	-0.244	-0.270
Pretest/retention test	*P*	<0.001	<0.001	<0.001	<0.001
	N	426	426	426	426

The central aspect of the study – demonstrating an association between emotional factors on learning as measured by situational emotions – was achieved, after accounting for the confounding effect of prior knowledge. These results are in line with studies dealing with motivation which showed also a positive association of motivation on achievement (Schiefele and Rheinberg, 1997). The results presented here are interesting since they explored a specific educational unit and domain-specific knowledge rather than investigating subject-specific knowledge in general and biographically developed trait-emotional variables. Pupils that expressed higher interest and higher well-being during the ecological unit performed better in a subsequent achievement test, while pupils that rated anxiety and boredom higher performed worse. In comparison with a study in physics education (Laukenmann *et al*., 2003), the results were rather similar, thus suggesting that these results may also prevail in other Science subjects.

One limitation of the study is that I was able to demonstrate some kind of association between emotional and achievement variables, rather than a causal relationship. However, structure equation modeling and path analysis in a previous study on physics teaching demonstrates some kind of causal relationship (Laukenmann *et al.,* 2003). Nevertheless, these aspects have to be under research in the future.

Further work should be organized as a prospective study, where treatments might be applied that try to enhance positive emotions in biology lessons and to measure the outcome in a strict treatment-control design. However, this seems far from simple, as was shown by Gläser-Zikuda *et al.* (2005). A theoretically based approach explicitly focusing on instructional strategies to enhance learners' emotions was labeled FEASP-approach (focusing on fear, envy, anxiety, sympathy, and pleasure; Astleitner, 2000). However, there has been no empirical evaluation of this approach. Both these approaches suggest the use of hands-on, learner centred variables, based on the theory of self-determination (Deci and Ryan, 1985). In the future, an interesting study might be to apply a treatment design based on these theoretical constructs.

REFERENCES

Astleitner, H. (2000). Designing Emotionally Sound Instruction: The FEASP-Approach. *Instructional Science* 28, 169-198.

Deci, E. L. and Ryan, R. M. (1985). *Intrinsic Motivation and Self-Determination in Human Behavior*. New York: Plenum.

Einsiedler, W. and Treinies, G. (1997). Effects of Teaching Methods, Class Effects, and Patterns of Cognitive Teacher-Pupil Interactions in an Experimental Study in Primary School Classes. *School Effectiveness and School Improvement* 8, 327-353.

Fraser, B. J., Walberg, H. J., Welch, W. W. and Hattie, J. A. (1987). Synthesis of Educational Productivity Research. *International Journal of Educational Research* 11, 145-252.

Gläser-Zikuda, M., Fuß, S., Laukenmann, M., Metz, K. and Randler, C. (2005). Promoting Students' Emotions and Achievement – Conception and Evaluation of the ECOLE Approach. *Learning and Instruction* 15, 481-495.

Laukenmann, M., Bleicher, M., Fuß, S., Gläser-Zikuda, M., Mayring, P. and Rhöneck, C. (2003). An Investigation on the Influence of Emotions on Learning in Physics. *International Journal of Science Education* 25, 489-507.

Pekrun, R., Götz, T., Titz, W. and Perry, R. P. (2002). Academic Emotions in Students' Self-Regulated Learning and Achievement: A program of qualitative and quantitative research. *Educational Psychologist* 37, 91-105.

Pintrich, P. R., Marx, R. W. and Boyle, R. A. (1993). Beyond Cold Conceptual Change. The Role of Motivational Beliefs and Classroom Contextual Factors in the Process of Conceptual Change. *Review of Educational Research* 63, 167-199.

Randler, C. and Bogner, F. X. (2009). Efficacy of two Different Instructional Methods Involving Complex Ecological Content. *International Journal of Science and Mathematics Education*, 7, 315-337.

Schiefele, U. and Csikszentmihalyi, M. (1998). Interest and the Quality of Experience in Classrooms. *Studies in Educational Psychology* 6, 1-23.

Schiefele, U. and Rheinberg, F. (1997). Motivation and Knowledge Acquisition: Searching for Mediating Processes. *Advances in Motivation and Achievement* 10, 251-301.

Uhlich, D. and Mayring, P. (1992). *Psychologie der Emotionen*. Stuttgart: Kohlhammer.