

# AUTONOMY-SUPPORTIVE TEACHING BEHAVIOR IN SCIENCE LESSONS – AN INTERVENTION FOR PRE-SERVICE TEACHERS

Nadine Großmann,<sup>1</sup> Stefan Fries,<sup>1</sup> and Matthias Wilde<sup>1</sup>

<sup>1</sup>Bielefeld University, Bielefeld, Germany

*Fostering students' motivation is an essential characteristic of every teaching process. However, teachers often lack practical methods to support it in class. There are several approaches to foster students' motivation, such as autonomy-supportive teaching behavior (ASTB) based on Self-Determination Theory (Ryan & Deci, 2017). Although these approaches are at disposal, they do not seem to find their way into practice. Consequently, efforts are needed to transfer theoretical and empirical findings into the classroom. An intervention for pre-service teachers providing theoretical and practical approaches to foster students' motivation might be appropriate to deal with this situation.*

*To address this issue, we conducted a pilot study with 58 science teacher trainees ( $M_{age}=25.18\pm 3.79$  years;  $M_{semester}=7.78\pm 1.23$ ; 65% female). The experimental group consisted of 35 teacher trainees that took part in an intervention about ASTB. Teacher trainees in the control group ( $n=23$ ) did not participate in this intervention. We assessed the teacher trainees' beliefs about the easy implementation and effectiveness of ASTB as well as their future intentions to apply ASTB. Furthermore, the teacher trainees' theoretical and practical knowledge were examined.*

*The results revealed significant differences concerning the teacher trainees' beliefs about ASTB, their future intentions to apply ASTB as well as their theoretical and practical knowledge thereof in the comparison of the experimental and control group. We found that the teacher trainees in the experimental group assumed ASTB to be more effective and easier to implement than the teacher trainees in the control group after the intervention. Moreover, the teacher trainees in the experimental group showed higher scores in the test of their theoretical and practical knowledge and stated higher intentions to apply ASTB than the teacher trainees in the control group after the intervention.*

**Keywords:** Motivation, Teaching Practices, Initial Teacher Education (Pre-service)

## INTRODUCTION

Despite numerous approaches in the field of teacher professionalization, there is still a degree of uncertainty regarding which implementations are most effective in this area (Pressley, Graham, & Harris, 2006). *Self-Determination Theory* (Ryan & Deci, 2017) has proved to be a useful framework for designing school-based interventions in various studies (Reeve & Cheon, 2016). These studies show that interventions can effectively change teaching behavior

in class (Reeve & Cheon, 2016; Su & Reeve, 2011). For these behavioral changes to take place, participants must recognize the relevance, the easy implementation, and the effectiveness of the communicated behavior (Reeve & Cheon, 2016; Su & Reeve, 2011). One opportunity to design a meaningful intervention is the subject-specific adaption and training of teaching behavior.

There is increasing evidence that interventions with teacher trainees are especially effective (e.g., Su & Reeve, 2011). With regard to autonomy-supportive teaching behavior (ASTB) in the sense of Self-Determination Theory (Ryan & Deci, 2017), teacher trainees are an important target group because they tend to use controlling teaching behavior in class (Martinek, 2010). Several studies have shown that controlling teaching behavior can have a negative effect on students' motivation (Assor, Kaplan, Kanat-Maymon, & Roth, 2005; De Meyer et al., 2016), whereas ASTB can influence their motivation positively (Basten, Meyer-Ahrens, Fries, & Wilde, 2014; Hofferber, Basten, Großmann, & Wilde, 2017; Taylor, Schepers, & Crous, 2006; Tessier, Sarrazin, & Ntoumanis, 2010). Since students' motivation decreases throughout their school career (e.g., Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002) and teachers often lack methods to foster it (Reeve, Jang, Carrell, Jeon, & Barch, 2004; Winther, 2006), the communication of ASTB seems to be especially important.

Based on this research, we developed an intervention to communicate ASTB to pre-service teachers. To successfully implement ASTB in class, teachers need theoretical and practical knowledge about autonomy support that is in accordance with Self-Determination Theory (Ryan & Deci, 2017). Therefore, we were interested in whether our intervention would foster the participants' acquisition of practical and theoretical knowledge with regard to ASTB. In addition, since teachers are more likely to implement ASTB when they are convinced that it is easy to implement and effective (Reeve & Cheon, 2016), we examined whether our intervention would have an impact on these beliefs and on the participants' future intentions to apply ASTB in their lessons.

## **THEORETICAL BACKGROUND AND CURRENT STATE OF RESEARCH**

*Basic Needs Theory*, a subtheory of Self-Determination Theory (Ryan & Deci, 2017), proposes that there are three innate basic psychological needs, namely the need for relatedness, competence, and autonomy. The degree to which these needs are satisfied has an impact on an individual's well-being and his or her quality of motivation (Deci & Ryan, 2000). The need for relatedness describes an individual's wish for meaningful interactions with significant others and striving to belong to a social community (Ryan, 1995; Ryan & Deci, 2017). The need for competence involves the ambition to perceive and extend one's own capability and effectiveness in an action (Deci, 1975; Deci & Ryan, 2000; Ryan & Deci, 2002, 2017). The need for autonomy describes an individual's desire to perceive him-/herself as origin of his or her action (Reeve, 2002; Reeve, Nix, & Hamm, 2003). Feeling autonomous means experiencing choice and volition in one's action (Reeve et al., 2003).

*Organismic Integration Theory*, a second subtheory of Self-Determination Theory (Ryan & Deci, 2017), depicts a continuum of motivation ranging from extrinsic to intrinsic motivation. The goal of an intrinsically motivated action is the action itself (Deci & Ryan, 2000; Vallerand & Ratelle, 2002). These actions are characterized by enjoyment, curiosity, and spontaneity (Deci & Ryan, 2000; Vallerand & Ratelle, 2002). Extrinsically motivated actions take place because the individual wants to obtain the result of an action that is separable from the action itself (Ryan & Deci, 2002; Vallerand & Ratelle, 2002). An extrinsically motivated action can be regulated in four different ways: external, introjected, identified, and integrated (Ryan & Deci, 2002, 2017; Vallerand & Ratelle, 2002). These types of regulation can be arranged on a continuum of self-determination (Ryan & Deci, 2002; Vallerand & Ratelle, 2002). An external regulation is the most heteronomous form of regulation whereas an integrated regulation is the most autonomous regulation (Vallerand & Ratelle, 2002).

Since these subtheories describe the needs and motivation of every individual, they are important for both students and teachers. The satisfaction of the three basic needs is essential for students' well-being and the quality of their motivation to learn as well as for well-being in the teaching profession and the motivation to teach (Martinek, 2012; Niemiec & Ryan, 2009; Reeve, 2002; Reeve & Cheon, 2016). In addition, the teacher's motivation to teach can have a direct and indirect impact on the students' motivation in class (Müller, Andreitz, & Hanfstingl, 2008; Pelletier, Séguin-Lévesque, & Legault, 2002). Studies have shown that students' motivation decreases throughout their school career (e.g., Jacobs et al., 2002). One opportunity to foster students' motivation in class is autonomy-supportive teaching behavior (ASTB) in the sense of Self-Determination Theory (Ryan & Deci, 2017). The positive effects of ASTB on students' motivation have been found in several studies (Basten et al., 2014; Hofferber et al., 2017; Taylor et al., 2006; Tessier et al., 2010). ASTB can also have a positive impact on students' knowledge acquisition (Boggiano, Flink, Shields, Seelbach, & Barrett, 1993; Hofferber, Eckes, & Wilde, 2014). Therefore, an intervention that communicates ASTB might be useful for the professionalization of teachers when it comes to fostering motivation. Since teachers often lack didactic-methodological skills to support their students' motivation in class (Reeve et al., 2004; Winther, 2006), the communication of this behavior is particularly important. Furthermore, interventions dealing with the Basic Needs Theory and Organismic Integration Theory might help teachers to reflect on the satisfaction of their own basic needs and their motivation to teach.

In addition to supporting students' motivation in class, Self-Determination Theory (Ryan & Deci, 2017) has turned out to be a suitable framework for designing school-based interventions (Chatzisarantis & Hagger, 2009; Reeve et al., 2004). Previous studies have found that these interventions can have a significant impact on not only the participants' knowledge and behavior, but also their beliefs and intentions (Aelterman, Vansteenkiste, Van den Berghe, De Meyer, & Haerens, 2014; Reeve & Cheon, 2016). In order for changes in beliefs and behavior to occur, the participants must first recognize the relevance, the easy implementation, and the effectiveness of the communicated concepts and behavior (De Naeghel, Van Kerr, Vansteenkiste, Haerens, & Aelterman, 2016; Reeve & Cheon, 2016; Su & Reeve, 2011). Furthermore, meta-analyses show that interventions with teacher trainees are especially effective (e.g., Su & Reeve, 2011). Teacher trainees do not yet have a stable

teacher personality and their teaching behavior in class is still flexible (Martinek, 2010; Tessier et al., 2010). Interventions that provide approaches to foster students' motivation should therefore already be implemented during the teacher training phases at the university level. On the basis of this research, we developed an intervention for pre-service teachers dealing with ASTB. To check the effectiveness of our intervention, we investigated the following research questions.

## RESEARCH QUESTIONS

- 1) Does the intervention foster the participants' acquisition of theoretical and practical knowledge about autonomy-supportive teaching behavior?
- 2) Does the intervention affect the participants' beliefs about the easy implementation and effectiveness of autonomy-supportive teaching behavior?
- 3) Does the intervention affect the participants' future intentions to apply autonomy-supportive teaching behavior?

## METHOD

### Sample

Fifty-eight science teacher trainees in advanced semesters ( $M_{age}=25.18\pm 3.79$  years;  $M_{semester}=7.78\pm 1.23$ ; 65% female) participated in the current study. These trainees came from courses that had prepared them for a one-semester practical phase. Thirty-five of them were assigned to the experimental group and took part in an intervention focusing on autonomy-supportive teaching behavior (ASTB) in science lessons. The control group ( $n=23$ ) did not participate in this intervention.

### Test instruments

We developed an open-ended knowledge test that contained seven items that assessed the teacher trainees' theoretical knowledge and eight items that assessed their practical knowledge of ASTB. We rated each item with zero, one, or two points. Zero points were awarded for an incorrect answer or when no answer was given at all. The teacher trainees received one point for an answer that was partly correct. Two points were given for a complete and correct answer. Interrater agreement for these items was found to be excellent (theoretical knowledge: Cohen's  $\kappa=.91$ ; practical knowledge: Cohen's  $\kappa=.93$ ).

The *Teaching Scenarios Measure* (TSM; Reeve et al., 2014) was used to examine the teacher trainees' beliefs about the easy implementation (four items) and the effectiveness (four items) of ASTB as well as their future intentions to apply ASTB (four items). Specifically, the teacher trainees received a written scenario that depicted ASTB. The term "autonomy-supportive" was not used in or to label the scenario. After reading the scenario, the teacher trainees were asked to rate different statements with regard to this scenario on a five-point

rating scale (“0=strongly disagree” to “4=strongly agree”). Both the knowledge test as well as the TSM were applied in the pre- and posttest.

In the posttest, we also investigated the teacher trainees’ perception of autonomy with nine items of the *Learning Climate Questionnaire* (LCQ; Black & Deci, 2000). In this test instrument, the experimental group stated their perception of autonomy during the intervention whereas the control group rated their perception of autonomy during their regular course. These items were rated on the same five-point rating scale. Internal consistencies as well as example items for all test instruments can be seen in Table 1. The Cronbach’s-alpha values for all test instruments ranged from satisfying to excellent.

**Table 1. Internal consistencies and example items for the applied test instruments.**

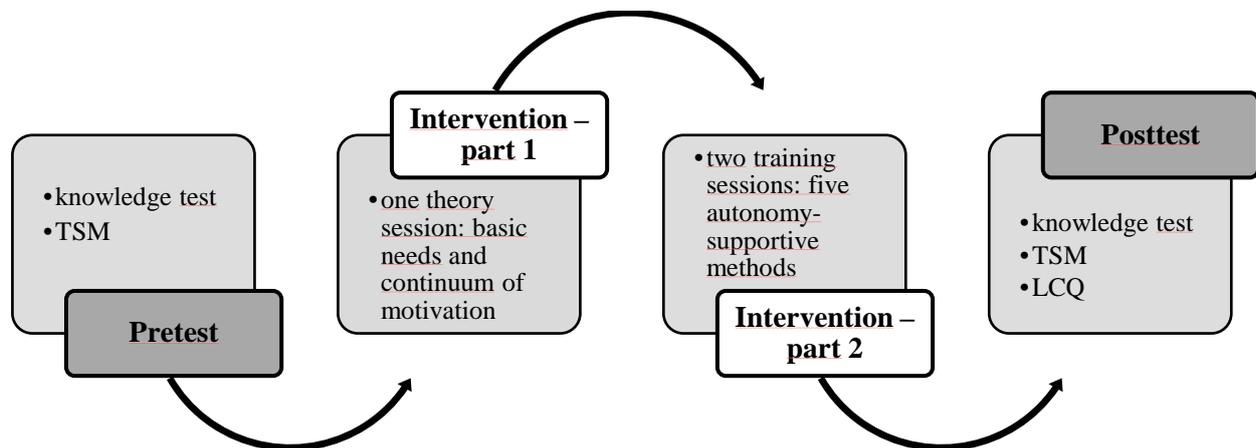
	Example item	Cronbach’s Alpha
<b>Theoretical knowledge test (seven items)</b>	Define an external regulation and give an example.	$\alpha_{\text{post}}=.67$
<b>Practical knowledge test (eight items)</b>	Give two examples of instructions that use neutral language from your science lessons.	$\alpha_{\text{post}}=.81$
<b>Teaching Scenarios Measure (Reeve et al., 2014)</b>		
<i>beliefs about the easy implementation</i> (four items)	This approach to teaching is easy to do.	$\alpha_{\text{post}}=.94$
<i>beliefs about the effectiveness</i> (four items)	This approach to teaching is effective in terms of motivating and engaging students.	$\alpha_{\text{post}}=.73$
<i>future intentions</i> (four items)	In the future, I intend to motivate my students this way.	$\alpha_{\text{post}}=.76$
<b>Learning Climate Questionnaire (nine items; Black &amp; Deci, 2000)</b>	The instructor provided me choices and options.	$\alpha=.88$

## Study design

One week before the intervention, the teacher trainees’ theoretical and practical knowledge regarding ASTB, their beliefs about this type of behavior, and their intentions to apply it in future lessons were assessed. The teacher trainees’ beliefs and intentions were measured

using the *Teaching Scenarios Measure* (TSM; Reeve et al., 2014). After that, the teacher trainees in the experimental group participated in an intervention that was divided into two parts. In the first part, they were provided with a theory session on Self-Determination Theory (Ryan & Deci, 2017), which had a special focus on the three basic needs and the continuum of motivation (*Basic Needs Theory, Organismic Integration Theory*). Afterwards, two training sessions took place in which five autonomy-supportive methods were practiced and discussed. After the intervention, the teacher trainees' knowledge, their beliefs that were related to ASTB and their future intentions to apply it were assessed again. Furthermore, the perceived degree of their own autonomy was examined using the *Learning Climate Questionnaire* (LCQ; Black & Deci, 2000).

The control group only attended the pre- and posttest and received no intervention. During the intervention, the teacher trainees in the control group participated in their regular course and prepared for the practical phase using different educational theories. The study design is summarized in Figure 1.



**Figure 1. Study design.** The Teaching Scenarios Measure (TSM; Reeve et al., 2014) assessed the teacher trainees' beliefs about and future intentions to apply ASTB. The Learning Climate Questionnaire (LCQ; Black & Deci, 2000) measured the teacher trainees' perceived degree of autonomy.

### Design of the sessions

While designing our intervention, we considered the findings of recent studies and meta-analyses of interventions based on Self-Determination Theory (Ryan & Deci, 2017). Among other things, these stressed that participants should perceive their own basic needs as being satisfied during the intervention (Assor, Kaplan, Feinberg, & Tal, 2009; De Naeghel et al., 2016). For this purpose, the instructor of the intervention implemented the communicated five autonomy-supportive methods during the intervention.

Studies have shown that interventions are particularly effective if they a.) are both knowledge- and skill-based, b.) do not exceed three hours per session, and c.) utilize different types of media (De Naeghel et al., 2016; Su & Reeve, 2011). To foster knowledge as well as skill acquisition, two types of sessions were designed: One session was designed to give the

teacher trainees theoretical input that teaches basic knowledge about the basic psychological needs and the different qualities of motivation according to Self-Determination Theory (Ryan & Deci, 2017); the second type consisted of two sessions designed to have the teacher trainees practice their skills in fostering their students' autonomy in science lessons. In the training sessions, five autonomy-supportive methods were focused on: providing rationales, acknowledging negative feelings, offering choices, using neutral language, and giving informative feedback (Table 2). In terms of methodology, these sessions were based on work in small groups. In their groups, the teacher trainees analyzed videos of different teaching behavior in class, designed rationales for topics in science lessons, and performed role plays dealing with negative feelings by way of example. At the end of each session, the introduced methods were reflected on and discussed. Audio and video sequences, tablets, laptops, smartphones as well as paper-and-pencil-based tasks were used in the sessions. Each one lasted 1.5 to 2 hours.

As continuous instrumental support and follow-up activities are important for an intervention to be effective (Assor et al., 2009; Su & Reeve, 2011), the teacher trainees were provided with a.) a glossary that included important definitions and assumptions related to Self-Determination Theory (Ryan & Deci, 2017), b.) a booklet for supporting students' motivation in class, and c.) a reader with theoretical discussions and empirical studies on the basic needs and the qualities of motivation anchored in Self-Determination Theory (Ryan & Deci, 2017). One follow-up activity entailed the observation of autonomy-supportive and controlling teaching behavior in class with a self-developed observation grid based on the *Learning Climate Questionnaire* (Black & Deci, 2000).

**Table 2. Five autonomy-supportive methods that were communicated in the intervention (cf. Su & Reeve, 2011).**

Method	Description
providing rationales	emphasizing the relevance of a topic or an action
acknowledging negative feelings	accepting, legitimating, and addressing negative feelings
offering choices	offering meaningful content-related and methodological choices
using neutral language	using language that imparts flexibility and minimizes pressure
giving informative feedback	presenting a students' performance with appreciation; giving advice for the further learning process

## Statistics

First, we calculated a univariate analysis of variance to investigate the teacher trainees' perceived degree of autonomy. To analyze the effects of the intervention on the teacher

trainees' knowledge, beliefs, and future intentions to apply ASTB, we used analyses of variance with repeated measures.

## RESULTS

First, we surveyed the teacher trainees' perceived degree of autonomy. The analysis of variance revealed a significant difference in the teacher trainees' perceived degree of autonomy between the experimental and the control group with a large effect size ( $F(1,57)=21.87, p<.001, \eta^2=.28$ ). The results of the *Learning Climate Questionnaire* (Black & Deci, 2000) showed that the teacher trainees in the experimental group stated a significantly higher perceived degree of autonomy during the intervention than the trainees in the control group in their regular course ( $M_{EG}\pm SD_{EG}=3.68\pm 0.27; M_{CG}\pm SD_{CG}=3.18\pm 0.55$ ). We therefore assume that the implementation of the autonomy-supportive behavior of the instructor during the intervention was successful.

Second, when it came to the extent of the teacher trainees' theoretical and practical knowledge regarding autonomy-supportive teaching behavior (ASTB), the analyses of variance with repeated measures revealed significant interaction effects of the factors time and treatment with large effect sizes (Table 3). The teacher trainees in the experimental group had higher scores on the theoretical and practical knowledge test than the teacher trainees in the control group after the intervention (Table 3).

**Table 3. Means (*M*), standard deviations (*SD*) and the results of the analyses of variance (ANOVA) with repeated measures for all applied test instruments.**

		<i>M</i> ± <i>SD</i> pretest	<i>M</i> ± <i>SD</i> posttest	Main effect time	Main effect treatment	Interaction effect time x treatment																																				
<b>Theoretical knowledge</b>	<i>EG</i>	2.33±1.99	5.94±2.14	$F(1,56)=94.48,$ $p<.001, \eta^2=.63$	$F(1,56)=35.43,$ $p<.001, \eta^2=.39$	$F(1,56)=40.19,$ $p<.001, \eta^2=.42$																																				
	<i>CG</i>	1.35±1.05	2.11±0.92				<b>Practical knowledge</b>	<i>EG</i>	4.56±2.34	11.57±1.96	$F(1,56)=173.35,$ $p<.001, \eta^2=.76$	$F(1,56)=54.29,$ $p<.001, \eta^2=.49$	$F(1,56)=82.73,$ $p<.001, \eta^2=.60$	<i>CG</i>	4.20±1.81	5.48±1.70	<b>Beliefs about the easy implementation</b>	<i>EG</i>	1.50±0.62	2.45±0.75	$F(1,56)=25.50,$ $p<.001, \eta^2=.31$	$F(1,56)=5.61,$ $p<.05, \eta^2=.09$	$F(1,56)=16.83,$ $p<.001, \eta^2=.23$	<i>CG</i>	1.54±0.82	1.64±0.70	<b>Beliefs about the effectiveness</b>	<i>EG</i>	2.92±0.42	3.34±0.47	$F(1,56)=17.98,$ $p<.001, \eta^2=.24$	$F(1,56)=3.17,$ $p<.1, \eta^2=.05$	$F(1,56)=3.17,$ $p<.1, \eta^2=.05$	<i>CG</i>	2.86±0.42	3.03±0.51	<b>Future intentions</b>	<i>EG</i>	2.90±0.64	3.40±0.61	$F(1,56)=10.53,$ $p<.01, \eta^2=.16$	$F(1,56)=3.07,$ $p<.1, \eta^2=.05$
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*Note. Means and standard deviations are shown for the experimental group (EG) and the control group (CG) in the pre- and posttest separately. With regard to the ANOVA, the main effects of the factors time and treatment as well as the interaction effect of both factors for the comparison of the experimental and control group are shown.*

Third, we found significant interaction effects with a large and a medium effect size of the factors time and treatment with respect to the teacher trainees' beliefs about the easy implementation of ASTB as well as their intentions to apply it in future lessons (*Teaching Scenarios Measure*; Reeve et al., 2014; Table 3). The interaction effect for the teacher trainees' beliefs about the effectiveness of this behavior showed a tendency with a small to medium effect size (*Teaching Scenarios Measure*; Reeve et al., 2014; Table 3). After the intervention, the experimental group thought ASTB was easier to implement and attributed higher ratings of effectiveness to this approach than the control group (Table 3). In addition, the teacher trainees in the experimental group stated higher intentions to apply ASTB after the intervention than the teacher trainees in the control group (Table 3).

## **DISCUSSION AND CONCLUSION**

The intervention seemed to be effective regarding the teacher trainees' theoretical and practical knowledge. Furthermore, it can be assumed that the intervention had a positive impact on the teacher trainees' beliefs about the effectiveness and the easy implementation of autonomy-supportive teaching behavior (ASTB) as well as their intentions to apply it in future lessons. The results of all scales are in line with theory and previous empirical findings. The minor tendency we found with regard to the beliefs about the effectiveness of ASTB may be reasonably attributed to the small sample size and/or ceiling effects. One should also consider that the teacher trainees had already indicated that they thought that ASTB is quite effective in the pretest. This is probably because the teacher trainees were in more advanced semesters of their studies and may have already been exposed to classroom autonomy support and its positive effects. Ceiling effects can further be assumed in the teacher trainees' perception of autonomy.

Learning environments that satisfy the learners' basic needs can have a positive effect on their motivation and knowledge acquisition (cf. Niemiec & Ryan, 2009; Reeve, 2002). Satisfying the need for autonomy is especially important for self-determined types of motivation and successful learning (e.g., Basten et al., 2014; Boggiano et al., 1993; Hofferber et al., 2017; Hofferber et al., 2014; Reeve, 2002; Taylor et al., 2006). We assume that the design of our intervention and the instructor's implementation of ASTB fostered the teacher trainees' perception of autonomy, the quality of their motivation, and consequently their knowledge acquisition.

Research has shown that interventions based on Self-Determination Theory (Ryan & Deci, 2017) can have an impact on participants' beliefs (Aelterman et al., 2014; Reeve & Cheon, 2016). Our data support the results of these studies. We assume that acquiring knowledge about and practicing ASTB in an autonomy-supportive setting with a range of choice and

without assessment had a positive influence on the teacher trainees' beliefs about ASTB. It may further be assumed that the changes in the teacher trainees' beliefs are indicators for a process of accommodating new concepts (cf. Reeve & Cheon, 2016; Tillema & Knol, 1997). Teacher trainees often harbor controlling teaching concepts and tend to exhibit controlling teaching behavior in class (cf. Martinek, 2010). The acquisition of knowledge about and the practice of ASTB might have led to a change of these existing concepts. Despite evidence of this change, we cannot confirm that the teacher trainees will actually use ASTB in their future lessons. Findings from previous studies show that the adoption and the use of new concepts are contingent upon existing beliefs about these concepts (e.g., Tillema & Knol, 1997). Tillema and Knol (1997) proved that a change in behavior can only be expected if the beliefs of an individual change. Hence, the positive impact of the intervention on the teacher trainees' beliefs about ASTB might result in a change of their behavior.

The reported intentions to apply ASTB may also indicate whether the teacher trainees will actually use the communicated methods in their future lessons. Intention is assumed to be a significant predictor of behavior in several social psychological models (cf. Sheeran, 2002). Since the teacher trainees' intentions to apply ASTB were positively affected by the intervention, it can be assumed that they will be more likely to apply it in their future lessons. Nevertheless, future studies should investigate whether and how the intervention affects the teacher trainees' teaching behavior in class. Furthermore, the effects of the trainees' teaching behavior after the intervention on their students' perception of autonomy and their students' motivation could be examined.

In order to further evaluate the effectiveness of our intervention, we plan to conduct follow-up surveys during the next semester. After a replication of the current pilot study, the intervention might be adapted to other subject-specific didactics and in-service teachers.

## ACKNOWLEDGEMENT

This project is part of the "Qualitätsoffensive Lehrerbildung", a joint initiative of the Federal Government and the *Länder* which aims to improve the quality of teacher training. The programme is funded by the Federal Ministry of Education and Research (funding code: 01JA1608). The authors are responsible for the content of this publication.

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