Examining positive emotions, autonomy support and learning strategies: Self-directed versus teacher-directed learning environments

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Received: 6 January 2021 / Accepted: 5 July 2021 / Published online: 10 July 2021
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Abstract

An increasing number of German schools have suspended teacher-directed learning (TL) in favor of self-directed learning (SL) modules. We used the broaden-and-build theory and self-determination theory as a theoretical framework to determine whether students in self-directed and teacher-directed learning environments differ in the interplay of positive emotions and learning strategies of students in secondary education. The study also compares the mediating role of autonomy support on the relationship between positive emotions and learning strategies. Questionnaire data from 787 German secondary school students in the sixth and seventh grades were analyzed. The results of the latent mean comparison indicated that students in the self-directed learning environment demonstrated more adaptive learning behaviors. Further, a multigroup structural equation model identified strong differences in the interplay of the variables between students in the self-directed and teacher-directed learning environments. In the teacher-directed learning environment, autonomy support was not found to mediate the relationship between positive emotions and learning strategies.

Keywords Autonomy support · Learning strategies · Positive emotions · Self-directed learning environment · Teacher-directed learning environment

Introduction

Students' positive emotions are an essential element of successful learning in school because they are directly related to learning strategies and performance (Harley et al., 2019; Pekrun et al., 2017). The link between positive emotions and learning strategies is aligned with Fredrickson's broaden-and-build theory (), which states that positive emotions enable individuals to develop new patterns of thinking and behavior. In turn, these patterns of thought and behavior contribute to students' development of learning strategies (Fredrickson, 2013). Because positive emotions facilitate both cognitive and social resources,

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autonomy support can be assumed to function as a mediating factor between positive emotions and learning strategies (Schweder & Raufelder, 2019). Self-determination theory (Deci & Ryan, 1985) emphasizes the critical function of the learning environment in this relationship because of its potential to satisfy students' basic needs (Ryan & Deci, 2020).

The relationships between learning environment, positive emotions and learning strategies are becoming increasingly important as many schools choose to enrich regular instruction with inquiry-based learning weeks that align with the principles of a self-directed learning environment (e.g., self-set learning objectives, learning at one's own pace, choosing learning strategies on the basis of one's own preferences and capabilities). However, few studies have investigated the effects of regular instruction compared with self-directed learning (De Brabander et al., 2009). To fill this gap, this study involved analyzing the relationships between positive emotions, autonomy support and learning strategies. The study's pronounced attention to learning environments is intended to deepen understanding about the learning environment's potential to act as a motivational driver of students' cognition in secondary schools.

Positive emotions and learning strategies

According to Fredrickson's broaden-and-build theory (1998, 2001), positive emotions (e.g., enthusiasm, joy, interest) are motivational impulses that lead to expanding patterns of thought and behavior. As interim cognitive and physiological impulses that expand human consciousness, positive emotions activate both cognitive and social resources, which leads to an increase in individuals' active and explorative examination of their learning environment. A recent study of a self-directed learning environment in a school context revealed that positive emotions facilitated early- and middle-adolescent students' learning behavior (Schweder & Raufelder, 2019). However, the study group was not compared to a similar group of students in a teacher-directed learning environment.

Positive emotions are predictors of learning behavior, which is defined as the willingness to apply control strategies, elaboration and persistence to learn new concepts (Artelt, Baumert, Julius-McElvany & Peschar, 2003; Harley et al., 2019; Pekrun et al., 2017). Control strategies include activities such as linking the student's present learning position to previously-set objectives, identifying and attempting to compensate for learning deficits and the willingness to observe one's own learning (Lens & Vansteenkiste, 2009; Pintrich & Garcia, 1994; Zimmerman & Schunk, 1989). Elaborative strategies are defined as the cognitive ability to link new knowledge to preexisting knowledge (Garner, 1988; Mandl & Friedrich, 2006; Weinstein & Mayer, 1986). The third component of learning behavior is persistence, which is defined as the strength of an individual's will to overcome challenges that arise (Artelt et al., 2003).

The broaden-and-build theory proposes that positive emotions expand individuals' awareness and patterns of thought and behavior. These changes lead to an increase in both cognitive and social resources, which in turn has positive effects on behavior (e.g., personal growth and development) over time (Fredrickson & Brainigan, 2005). In a learning environment, autonomy support is assumed to mediate the association between positive emotions and learning strategies. However, it is unclear how autonomy support mediates this relationship and how the teacher's role transforms from instructing students' learning (teacher-directed learning environment) to facilitating students' learning (self-directed learning environment). Teachers are a key component of both types of

learning environment because their teachers' actions affect students' learning (Costa & Kallick, 2004; Hattie, 2009; Kulakow, 2020).

Autonomy support as a potential mediator

Teachers provide autonomy support by using various measures to help students to solve learning problems independently (Diseth et al., 2017). For example, teachers can provide individualized feedback on learning strategies (Hattie, 2009), provide multiple options for learning tasks (Kulakow, 2020), empower students to participate in learning (Baeten et al., 2010), account for students' interests and preferences (Lazarides et al., 2019), tolerate mistakes, and set individualized reference standards for measuring performance (Hornstra et al., 2015; Jang et al., 2010; Mouratidis et al., 2017; Nett & Götz, 2019; Usher & Schunk, 2018; Vansteenkiste et al., 2012). Empirical findings have identified positive links between autonomy support and positive emotions during lessons (Barrable, 2020; Reeve et al., 2004), persistence (Isen & Reeve, 2005; Reeve et al., 2004), elaboration (Nijhuis et al., 2008; Reeve & Jang, 2006) and control strategies (Reeve, Ryan, Deci & Jang, 2009). Therefore, the existing body of research confirms the assumption that autonomy support acts as a mediating factor between positive emotions and learning strategies. However, it remains unclear whether the interplay of emotions, learning strategies and autonomy support differs between self-directed and teacher-directed learning environments (Kulakow, 2020; Schweder & Raufelder, 2019).

Self-directed versus teacher-directed learning environment

The learning environmental framework can support or hinder students' self-determination and perceptions of positive emotions (Ryan & Deci, 2017), with significant factors of the learning environment including the extension of learning strategies and students' and teachers' willingness to apply them (Fredrickson & Brainigan, 2005). In a self-directed learning environment, students are responsible for developing and implementing learning objectives and reflecting on their learning processes (Van Deur, 2020). Teachers in self-directed learning environments do not instruct; instead, they facilitate students' self-organized learning processes at all stages (Bolhuis & Voeten, 2004; Gibbons, 2002; Knowles, 1980; Saks & Leijen, 2014; Van Deur, 2020; Voskamp et al., 2019). The teacher's task is to support students in identifying their own learning objectives, facilitating the process of learning toward those objectives and reflecting on past processes (Voskamp et al., 2019). These are key differences from the regular instructional environment in which teachers are primarily responsible for directing students' learning processes (Juliani, 2015). Empirical evidence suggests that teacher-directed learning environments suppress the potential for satisfying students' basic needs (Benware & Deci, 1984). In turn, this suppressed potential affects the development of positive emotions (Schweder & Raufelder, 2021a) and their effect on learning strategies (Fredrickson, 2013; Ryan & Deci, 2017) such as effort and persistence (Pintrich & Garcia, 1994; Schunk & Zimmerman, 2012), student willingness to control learning progress (Corno, 1989; Schweder, 2019; Winne & Hadwin, 1998) and elaboration (Ames, 1992).

The present investigation

Limited research is available regarding the differences between self-directed and teacher-directed learning environments (Kulakow & Raufelder, 2020; Raufelder & Kulakow, 2021; Schweder & Raufelder, 2021b, 2021c; Schweder et al., 2019, 2020). The current trend in schools is to include self-directed learning modules (see Fig. 1) as an extended framework for students to explore content or objects of interest on their own. This extension of the regular teacher-directed learning environment occurs for the duration of one school week twice during the school year. During this time, teachers suspend regular instruction and instead facilitate students' self-directed learning processes (Schweder, 2015). Our study uses the broaden-and-build theory and self-determination theory as a theoretical framework to determine whether students in self-directed and teacher-directed learning environments differ in the interplay of positive emotions and learning strategies. Additionally, student perceptions of autonomy support were tested as a possible mediator of these relationships. The study aimed to expand existing research findings regarding self-directed learning, which have primarily focused on adults (Yasmin et al., 2019). It also enriches the field of research based on the broaden-and-build theory by contributing findings among a group of early adolescents in dissimilar learning environments.

The self-directed learning environment studied in the present investigation was structured as follows. In the first phase, the teacher guided students to develop ideas about their preferred subject of inquiry and learning approach. As a next step, the teacher helped students to formulate learning objectives, hypotheses and learning strategies; anticipate possible results; identify potential materials and sources; and define a learning timeline. During the second self-directed learning phase, students continually compared their learning status to the previously-developed learning objectives and paths that they had shaped in the first phase (planning); therefore, students were able to adapt their subsequent learning strategies according to their individualized plans (see Fig. 1).

The teacher-directed learning environment examined in this study required the teacher to convey knowledge to students, use exercises and assignments to deepen this knowledge, and make adjustments according to curricular learning requirements.

Hypotheses

Based on the research framework described above, it is assumed that the mean reports of positive emotions and autonomy support of students in the self-directed learning

Fig. 1 Structure of the self-directed learning module for five school days

environment will be higher than those of students in the teacher-directed learning environment (H1). It is further assumed that autonomy support will mediate the association between positive emotions and learning strategies such that the relative strength of the learning environment will affect the interplay of these variables (H2) (see Fig. 2).

Methods

Sample

The investigation relied on self-assessment data collected from 787 students in the sixth and seventh grades ($M_{age} = 12.9$; $SD = 0.70$; 53.6% female) at nine schools in Mecklenburg-Western Pomerania and Schleswig-Holstein. Of this sample, 401 students ($M_{age} = 12.8$; $SD = 0.67$; 54.6% female) at five schools participated in an self-directed learning (SL) environment according to the same concept (Fig. 1). In each of these five schools, the spectrum of lessons—most of which were traditional and canonized—was regularly complemented by one-week (five school-days) SL phases, which were implemented once per semester (twice per academic year) at the schools. Survey data from 386 students ($M_{age} = 12.9$; $SD = 0.72$; 52.7% female) in a teacher-directed learning (TL) environment came from four randomly-selected regional schools in Mecklenburg-Western Pomerania that follow traditional TL, characterized by the key difference against SL, such as planning the lessons without students' participation.

Procedure

The Mecklenburg-Western Pomeranian Ministry of Education, Science and Culture and the Schleswig-Holstein Ministry of Education and Science approved the collection of data for this study. The parents of adolescents who participated in the study and the adolescents themselves provided informed consent to participate. When informed about the study,

Fig. 2 Path model summarizing the variables being tested

participants were told that the data would be treated confidentially. To ensure valid data collection, two test administrators were present during surveys to help the students if anything was unclear.

Measures

All data for the following variables were based on a 4-point Likert scale that ranged from 1 (Strongly Disagree) to 4 (Strongly agree).

Positive emotions

Positive emotions (e.g., “I perceive learning as exciting” or “I perceive learning as fascinating”) were measured using a survey developed for German students by Prenzel, Kristen, Dengler, Ettle, and Beer (1996) (total: $\alpha=0.81$; SL: $\alpha=0.82$; TL: $\alpha=0.78$; five indicators).

Autonomy support

Perceived autonomy support (e.g., “Teacher encourages me to ask my own questions”) was measured (total: $\alpha=0.81$; SL: $\alpha=0.84$; TL: $\alpha=0.78$; five indicators) using a questionnaire for German students based on an adapted subscale that was validated by Müller and Thomas (2011).

Learning strategies

Three sub-surveys were used to measure the components of students’ learning. These surveys were elements taken from a validated survey that measured German students’ self-regulated learning in the “Program for International Student Assessment” (PISA; Artelt, Baumert, Julius-McElvany, & Peschar, 2004). The elements measured included persistence (e.g., “When studying, I put forth my best effort”) (total: $\alpha=0.81$; four indicators), elaborative learning strategies (e.g., “When I study, I try to understand the material better by relating it to things I already know”) (total: $\alpha=0.74$; four indicators), and control strategies (e.g., “When I study and I don’t understand something, I look for additional information to clarify the point”) (total: $\alpha=0.74$; five indicators).

Statistical analyses

The statistical software Mplus 8.1 (Muthén and Muthén 1998–2018) was used to evaluate the nested data from 787 students in 36 classes. The software was programmed using the maximum likelihood and robust maximum (MLR) estimators so that the standard error for the model could be corrected using type-is-complex programming (Asparouhov, 2005). Missing data were handled with full-information-maximum-through-likelihood (FIML).

Latent mean comparison

The means of all variables were compared for both subsamples using the staged procedure presented by Brown (2015). This procedure was used to compare models with various restrictions in a confirmatory factor analysis (CFA), with each restricted model being

evaluated for significance using a chi-square test (χ^2 -difference test) (Yuan & Bentler, 2004). For the baseline CFA model, an equivalent factor structure was assumed. The second CFA model (metric) was more restrictive than the baseline and required additional equal factor loadings. In a third CFA model (scalar), an additional restriction assumed same intercepts. If the χ^2 -difference test between the more restrictive CFA models (metric and scalar) was not significant, it would be possible to compare the means of variables across groups (Geiser, 2011). The five fit indices—chi-square test of model fit (χ^2), comparative fit index (CFI), Tucker-Lewis Index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR)—were compared to one another to account for potential concerns about using the χ^2 -difference test for the small study sample size (Yuan & Bentler, 2004). Models with $\Delta\text{RMSEA} \leq 0.015$, $\Delta\text{CFI} \leq 0.010$, and $\Delta\text{TLI} \leq 0.010$ were preferred (Cheng, 2007).

Multigroup structural equation modelling (MGSEM)

The χ^2 -difference test was used to test two models with different restrictions, both of which included direct and indirect effects, to evaluate whether the interplay of variables differed between the SL and TL environments. The first model (Model 1) assumed differences between direct and indirect effects and covariances. In the second model (Model 2), these assumptions were excluded. If the result of the χ^2 -difference test was significant, differences could be identified in the interplay of variables between the two subsamples. Distorting effects that were not the result of a non-normatively distributed sample were accounted for by considering the confidence intervals in the evaluation of the results on the indirect effects.

Results

Descriptive statistics and intercorrelations

All values for intercorrelations, means, standard deviations, skewness, and kurtosis are shown in Table 1.

Latent means comparison

The χ^2 -difference test results and the comparison of the fit indices of three different restricted CFA models [baseline CFA: $\chi^2(440)=636.40$; $p<0.001$; CFI=0.96; TLI=0.95; RMSEA=0.03(0.03–0.04); SRMR=0.04; metric CFA: $\chi^2(463)=663.37$; $p<0.001$; CFI=0.97; TLI=0.96; RMSEA=0.03(0.03–0.04); SRMR=0.06; scalar CFA: $\chi^2(481)=693.14$; $p<0.001$; CFI=0.96; TLI=0.96; RMSEA=0.03(0.03–0.04); SRMR=0.06] indicated no significant difference between the baseline and metric CFA [$\chi^2(23)=28.03$; $p=0.21$; $\Delta\text{RMSEA}=0.000$; $\Delta\text{CFI}=0.000$; $\Delta\text{TLI}=0.002$] or the metric and scalar CFA [$\chi^2(18)=28.11$; $p=0.06$; $\Delta\text{RMSEA}=0.000$; $\Delta\text{CFI}=0.003$; $\Delta\text{TLI}=0.001$]. The resulting scalar measurement invariance enables comparison of the mean values of all variables between both groups (Geiser, 2011). Compared with students in the SL environment (reference group), students in the TL environment reported significantly lower mean values for positive emotions (estimate = -0.42 , $p<0.001$). However, students in the TL and SL environments did not significantly differ in their perceptions of autonomy support.

Table 1 Bivariate correlations, means, range, standard deviations, skewness (SE) and kurtosis (SE)

Variables	Correlations				M	Range	SD	Skewness (SE)	Kurtosis (SE)
	1	2	3	4					
<i>6th/7th graders SL</i>									
1 positive emotions					2.7	1–4	.68	−.07 (.12)	−.47 (.24)
2 autonomy support	.38**				2.9	1–4	.65	−.30 (.12)	−.11 (.24)
3 elaboration	.51**	.31**			2.8	1–4	.60	.08 (.12)	−.53 (.24)
4 persistence	.53**	.39**	.57**		3.1	1–4	.64	−.45 (.12)	−.27 (.24)
5 control strategies	.45**	.40**	.53**	.56**	2.9	1–4	.56	−.20 (.12)	.13 (.24)
<i>6th/7th graders TL</i>									
1 positive emotions					2.4	1–4	.61	.29 (.12)	−.07 (.25)
2 autonomy support	.33**				2.8	1–4	.61	−.08 (.12)	−.17 (.25)
3 elaboration	.44**	.23**			2.6	1–4	.57	−.07 (.12)	.17 (.25)
4 persistence	.49**	.29**	.44**		2.8	1–4	.60	−.16 (.12)	−.42 (.25)
5 control strategies	.40**	.22**	.57**	.58**	2.8	1–4	.55	.04 (.12)	−.25 (.25)

* $p < .05$, ** $p < .001$

Multigroup structural equation modelling (MGSEM)

Both Model 1 [$\chi^2(472)=646.01$; $p < 0.001$; CFI=0.97; TLI=0.96; RMSEA=0.03(0.03–0.04); SRMR=0.05] and Model 2 [$\chi^2(484)=667.19$; $p < 0.001$; CFI=0.96; TLI=0.96; RMSEA=0.03(0.03–0.04); SRMR=0.05] showed good fit indices. The χ^2 -difference test results [$\chi^2(8)=19.62$, $p < 0.05$] indicated that Model 1 did not differ significantly from Model 2 in its representation of the data. Therefore, substantial between-group differences can be assumed to exist in the interplay of the variables examined (Yuan & Bentler, 2004).

Patterns for students in SL environment

Direct effects

All direct effects of positive emotions on the outcome variables [elaboration ($B=0.75$, $\beta=0.56$, $SE=0.13$, $p < 0.001$), persistence ($B=0.77$, $\beta=0.51$, $SE=0.12$, $p < 0.001$), and control strategies ($B=0.51$, $\beta=0.40$, $SE=0.14$, $p < 0.001$)] were significant. The direct effect of positive emotions on the mediator variable (autonomy support; $B=0.66$, $\beta=0.44$, $SE=0.12$, $p < 0.001$) was also significant.

Indirect effects

Two significant mediating effects for autonomy support were identified. The first mediating effect was between positive emotions and control strategies ($B=0.18$, $\beta=0.14$, $SE=0.05$; 95% CIs [0.05, 0.32]) and the second was between positive emotions and persistence ($B=0.16$, $\beta=0.10$, $SE=0.06$; 95% CIs [0.00, 0.31]).

Covariances

Significant covariances were identified between persistence and elaboration ($r=0.54$, $p<0.001$), control strategies and persistence ($r=0.54$, $p<0.001$), and elaboration and control strategies ($r=0.57$, $p<0.001$).

Variance

This model detected 18.9% of the variance of perceived autonomy support ($R^2=0.189$), 38.4% of the variance of control strategies ($R^2=0.384$), 41.2% of the variance of elaboration ($R^2=0.189$), and 42.4% of the variance of persistence ($R^2=0.422$) (see Fig. 3).

Patterns for students in TL environment

Direct effects

Significant direct effects were identified between positive emotions and autonomy support ($B=0.70$, $\beta=0.43$, $SE=0.22$, $p<0.01$), elaboration ($B=0.81$, $\beta=0.56$, $SE=0.14$, $p<0.001$), persistence ($B=0.91$, $\beta=0.58$, $SE=0.14$, $p<0.001$), and control strategies ($B=0.71$, $\beta=0.49$, $SE=0.13$, $p<0.001$). However, no significant effect was identified between autonomy support and elaboration, persistence, or control strategies.

Indirect effects

No significant indirect (mediating) effects were detected.

Fig. 3 MGSEM for 6th/7th graders in a self-directed learning environment. Effects presented as first (bold) unstandardized coefficients (B); second standardized coefficients (β); bold pathways are significant at $*p<.05$, $**p<.01$, $***p<.001$; factor loadings are standardized

Covariances

Significant covariances were identified between persistence and elaboration ($r=0.38$, $p<0.001$), persistence and control strategies ($r=0.70$, $p<0.001$) and elaboration and control strategies ($r=0.81$, $p<0.001$).

Variance

This model detected 18.9% of the variance of perceived autonomy support ($R^2=0.189$), 28.4% of the variance of control strategies ($R^2=0.284$), 35.3% of the variance of elaboration ($R^2=0.353$) and 40.5% of the variance of persistence ($R^2=0.405$; see Fig. 4).

Discussion

The aim of this study was to contribute new information about the differences in learning processes in SL and TL environments. The existing body of research includes few empirical studies that have compared these two learning environments. Based on the broaden-and-build theory (Fredrickson, 1998, 2001), the objective of this study was to investigate the interplay of positive emotions and learning strategies among early adolescent students. Additionally, teacher autonomy support was tested as a possible mediator of this relationship.

Students in the SL environment reported significantly more positive emotions than those in the TL environment, as proposed in hypothesis 1. Research related to self-determination theory has demonstrated that the fulfillment of students' basic needs (e.g., autonomy, competence, social relatedness) is associated with positive emotions (Benita et al., 2014; Ryan & Deci 2000). Therefore, it is possible that the SL environment better satisfies students' basic needs than the TL environment; this theory could be examined in future studies. In the SL environment, students' need for autonomy is likely to be met because they set their

Fig. 4 MGSEM for 6th/7th graders in a teacher-directed learning environment. Effects presented as first (bold) unstandardized coefficients (B); second standardized coefficients (β); bold pathways are significant at $*p<.05$, $**p<.01$, $***p<.001$; factor loadings are standardized

own learning objectives, paths, conditions and type of learning results. Students' need for competence is also fulfilled in the SL environment because they are encouraged to consider their prior knowledge and capabilities when planning and implementing learning objectives and they use an individual reference framework to measure their individual learning progress. Students' need for social relatedness also could be better fulfilled in an SL environment than a TL environment because teachers in the SL context facilitate students' self-guided learning processes and respond to individual needs. Students work with other students and can therefore continually exchange ideas. Other studies have confirmed that learning conditions that fulfill students' basic needs are associated with positive emotions (Hascher & Hagenauer, 2018).

The mean differences in learning strategies between students in SL and TL environments can also be discussed in the framework of the control-value theory (Pekrun, 2006). Students in the TL environment have control experiences if the tasks set by the teacher during lessons correlate with the students' prior knowledge and abilities. However, because this is not the case for all students, not all students experience positive emotions. Because the TL environment is not intended to include students in the entire range of the lesson, students' value convictions decrease. Other studies have demonstrated that positive emotions decrease in proportion to value convictions (Ames, 1992; Boekaerts, 2007; Pekrun & Perry, 2014; Ranelluci et al., 2015).

In contrast to hypothesis 1, students in the SL and TL environments did not differ significantly in their experiences of autonomy support. Students perceived their teachers as supportive in both learning environments. However, these findings do not provide detailed information about the type of autonomy support that is perceived. In the SL environment, teachers offer a variety of learning support because each student's learning path is different (Bolhuis & Voeten, 2004). Therefore, students do not need to adapt to the specific support strategies provided by the teacher. In TL, teacher autonomy support is intended to meet the needs of a large number of students. If the teacher has selected a certain assignment for the whole class to complete, the teacher can provide supportive instructions to the class that are tailored to this assignment. In this case, most of the students would feel supported.

Hypothesis 2 was confirmed in that students in SL and TL environments substantially differed in the interplay among positive emotions, autonomy support and learning strategies. These findings provide empirical support for self-determination theory, which emphasizes the role of the learning environment as an environmental framework that can shape students' positive emotions (Deci, 1992), learning strategies (Schweder & Raufelder, 2021a) and perceptions of autonomy support (Barrable, 2020; Bonem et al., 2020; Hornstra et al., 2015). The results also indicate that the paths between positive emotions and persistence and between positive emotions and control strategies were partially mediated by autonomy support only for students in the SL environment. These findings provide support for the broaden-and-build theory. They are also aligned with a prior study of an SL environment for early and middle adolescent students, which revealed that teacher support partially mediated the relationship between positive emotions and learning behavior (Schweder & Raufelder, 2019). In other words, the effect of teacher autonomy support on learning strategies is stronger than the effect of teacher autonomy support on positive emotions in the SL environment. This result is aligned with findings reported by Hattie (2009) and Kirschner et al. (2006).

The primary reason that no mediating effect was identified for students in the TL environment is that none of the three direct paths from perceived teacher autonomy support to learning strategies was significant. Therefore, teacher autonomy support in the TL environment had no effect on students' learning strategies. This finding is surprising because

TL students are directed and moderated by the teacher; therefore, perceived teacher autonomy support would be expected to affect students' learning strategies. The means for perceived autonomy support did not differ significantly between students in the SL and TL environments, which suggests that perceived autonomy support is irrelevant for students' learning strategies in the TL environment. This result contradicts prior findings based on self-determination theory, which have indicated that teacher autonomy support facilitates students' learning processes (Benita et al., 2014; Reeve et al., 2009). Therefore, students in TL environments lack a resource that students in SL environments can use to compensate for a deficit in positive emotions regarding an adaptive use of learning strategies. If teacher autonomy support has no effect on students' learning strategies, it is unclear to what extent the three basic needs of competence, autonomy and social relatedness are met in TL environments.

Conclusion, limitations, strengths and future directions

Several limitations in the research design must be considered when interpreting these study findings. First, the study was based on self-reported data because the focus was students' perceptions and experiences. Future studies could include additional data from other sources (e.g., teachers) to consider multiple perspectives on lessons. In addition, the cross-sectional nature of the study does not permit any statements about causality. Future longitudinal studies could describe emotional experiences and learning processes over time. For example, a mixed-methods approach that incorporates classroom observations could offer important clues about qualitative differences between SL and TL environments (e.g., the ways in which teachers give support and adopt SL and TL principles). The latter approach could be controlled using student and teacher assessments in questionnaires. Future studies that examine the type of autonomy support provided to students (e.g., by observing lessons) are necessary to empirically review these suppositions.

Future studies could provide a detailed examination of the quality of teachers' support for autonomy in SL and TL environments. Researchers could contrast the extent to which students' basic needs are satisfied in SL and TL environments in order to evaluate possible explanations for the findings of the present study.

Despite these limitations, the study makes an important contribution to academic research that accompanies practical school lessons by contrasting learning strategies and positive emotions of students in SL and TL environments. It also expands the body of research findings on SL to include early adolescents. These results confirm aspects of broaden-and-build theory as well as self-determination theory.

Acknowledgements This research was supported in part by a grant (01JA1614C) from the Bundesministerium für Bildung und Forschung Germany.

Funding Open Access funding enabled and organized by Projekt DEAL.

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