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Adolescents' expectancy–value profiles in school context: The impact of self-directed learning intervals

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Abstract

Introduction: Using the situated expectancy–value theory, it becomes possible to explain motivational functioning across alternating learning conditions not only at a particular moment but also over time. The situated expectancy–value theory provides evidence for the critical role of context. The present research examines how adolescents' success expectancies, task values, and effort develop when the conditions of the academic environment change. It also evaluates whether adolescents adopt more adaptive expectancy–value profiles in response to the need-based nature of self-directed learning as an extension of regular instruction. Within the self-directed learning approach under investigation, adolescents take responsibility for their own learning processes.

Methods: The present research offers insights into the expectancy–value profiles of 754 German adolescents (M_{age} = 13.56; SD = 1.2; 49.4% female). A four-wave study was used to examine perceptions of self-efficacy, intrinsic value, utility value, and effort. Latent profile analyses and latent transition analyses were employed.

Results: Notably, the results provide evidence that expanding instruction via self-directed learning intervals that occur for 1 week per semester contributes to more favorable expectancy–value profiles within a student's favorite subject. A mixed profile (highly confident, hardly interested) disappeared. Instead, success expectations aligned more closely with adolescents' task values and effort. All profiles settled at a higher level.

Conclusions: The findings indicate that instruction that is expanded via self-directed learning intervals has positive consequences for motivational profiles over time. An initial self-directed learning episode led to a shift to more interested profile groups. The continuation of a positive trend even after a self-directed learning interval indicates that adolescents are able to continually adapt their learning to their needs during teacher-directed instruction. This study provides clues about how to design curricula in a way that counteracts the downward trend in students' motivation to learn.

KEYWORDS

achievement, attitudes and beliefs, motivation, self-competence/self-efficacy, school environment, environmental factors

1 | INTRODUCTION

Achievement motivation is a critical prerequisite for adolescents' success in compulsory education and educational attainment (Diaconu-Gherasim et al., 2020; Wigfield & Gladstone, 2019). In view of the empirical findings that prove a downward trend in adolescents' achievement motivation (Wigfield & Wagner, 2017), it is becoming important to consider learning conditions. Eccles and Wigfield (2020) recently expanded their expectancy–value theory of achievement motivation. They renamed it "situated expectancy–value theory" to more clearly emphasize the situational nature of the expectancy–value theory. Using the situated expectancy–value theory, it becomes possible to explain motivational behaviors and associated situated cognitive and social behaviors not only for the moment but also over time (Eccles & Wigfield, 2020). In other words, the two key components of the model—namely, success expectations and task values, both of which determine adolescents' achievement motivation—are to be closely considered in a given context.

The present study adopted Eccles and Wigfield's model to investigate how adolescents' success expectancies, task values, and effort develop over the course of a school year when the adolescents' learning situations alternate during this timeframe. Precisely twice per year, an interval of self-directed learning expands regular teacher-directed instruction. This study joins a number of person-oriented expectancy–value theory studies that have identified different expectancy–value profiles (Dietrich & Lazarides, 2019; Lazarides, Dicke, et al., 2019; Lazarides, Dietrich, et al., 2019; Lazarides, Viljaranta, et al., 2016; Nurmi & Aunola, 2005; Viljaranta et al., 2016). None of these studies examined situational context as postulated by situated expectancy–value theory, however. Therefore, the goals of the present research were to determine (a) whether expectancy–value profiles similar to those found in previous studies can be identified, (b) whether these profiles are stable even when adolescents' learning conditions change as a result of two intervals of self-directed learning, and (c) whether adolescent students adopt more favorable expectancy–value profiles in response to the need-based nature of self-directed learning (Schweder & Raufelder, 2021b).

1.1 | Person-oriented studies in the framework of the situated expectancy–value theory

Situated expectancy–value theory states that motivation is determined by success expectancies. This term refers to an adolescent's expectations that he or she will be able to complete an assignment successfully. Such expectancies are usually operationalized as domain-specific academic self-concepts or self-efficacy. The situated expectancy–value theory also indicates that motivation is determined by four task values that provide information about the value that a student assigns to a learning task. The values are, first, attainment value, which encompasses the personal significance that an adolescent ascribes to an assignment; second, intrinsic value, which encompasses an adolescent's interest in and enjoyment of an assignment; third, utility value, which concerns the importance of an assignment to an adolescent's future; and, fourth, cost value, which contrasts with the three other values insofar as it encompasses the negative consequences of completing an assignment. Most person-oriented studies have ignored cost value (except Dietrich & Lazarides, 2019; except Dietrich et al., 2019 based on a sample of university students; see Flake et al., 2015). This is because cost value is a multidimensional construct that many scholars consider difficult to operationalize (see Eccles & Wigfield, 2020). It is also a separate factor from the other three task values (Chiang et al., 2011; Dietrich et al., 2019; Eccles & Wigfield, 2020; Flake et al., 2015; Perez et al., 2014). As an alternative to the cost value, the present investigation analyzed effort. Effort is a measure of how much energy a person uses to implement tasks (Buenz & Merril, 1968; Efklides et al., 2018). As a motivational factor, effort determines an individual's willingness to pursue learning goals even in the face of obstacles (Artelt et al., 2003; Brunstein & Heckhausen, 2006).

Previous person-oriented studies conducted within the framework of the expectancy–value theory have identified student profiles that differ in terms of low, medium, and high expectancy–value beliefs in a two-wave study of German math students from college-bound track and mixed track schools, Grades 9–10 (Dietrich & Lazarides, 2019); in a four-wave study of US math students, Grades 7–12 (Lazarides, Dicke, et al., 2019); and in a four-wave study of four Finnish primary school students in math and reading (Nurmi & Aunola, 2005). The results of these studies differ from those of other research projects in terms of mixed expectancy–value profiles, including a profile with low interest but high belief or confidence, which was found in a 2-wave study of Finnish primary school students in math and reading (Viljaranta et al., 2016), as well as in two 2-wave studies of German math students from college-bound track and middle track schools, Grades 9–10 (Lazarides, Dietrich, et al., 2019; Lazarides, Viljaranta, et al., 2016). The transition studies conducted in secondary schools show that most profiles have a high degree of stability (15%–47%). Nonetheless, particularly in primary education, students occasionally switch from their respective profiles to less favorable (40%–50%) expectancy–value profiles (Viljaranta et al., 2016). The latest studies underscore the existence of significant inter- and intra-individual differences among secondary students' expectancy–value profiles (Lazarides, Dicke, et al., 2019; Lazarides, Dietrich, et al., 2019).

None of these studies has examined in detail the situational aspects that influence adolescents' task values and success expectations. These aspects include specific teaching styles, a change of schools, different learning conditions, and the classroom's social structure. Addressing these factors becomes increasingly important as adolescents grow older; as this

happens, their success expectations and task values become much more sophisticated, conscious, and stable (Eccles & Wigfield, 2020). Eccles and Wigfield (2020) assumed that, with increasing social and cognitive development (i.e., maturity), the relationship between subjective task values and situational demands and characteristics changes or, alternatively, that these two dimensions relate differently to one another. The theory assumes that motivational patterns change over time and according to different situations.

Adolescents' increasing social and cognitive maturity is accompanied by a downward tendency in their achievement motivation, which reaches its nadir in Grade 9 and recovers slightly thereafter (Eccles & Wigfield, 2002; Fredricks & Eccles, 2002; Jacobs et al., 2002; Watt, 2004). The stage–environment fit theory (Eccles et al., 1993), which has also been incorporated into the situated expectancy–value theory (Eccles & Wigfield, 2020), explains this decline with reference to a mismatch between the needs of adolescent students and the opportunities that their classroom learning environments actually afford them.

1.2 | Situational contexts: teacher-directed instruction expanded via self-directed learning intervals

Although the stage–environment fit theory focuses on situational context, the situated expectancy–value theory expands on the influence of situational aspects. In this regard, Nolen (2020) has stated that students' self-reported task values could be considered as the "residue" of their participation in the social contexts in which meanings are constructed. Empirical research conducted on the basis of questionnaire data continues to determine current motivational research. Nevertheless, especially in regard to the situated expectancy–value theory, only limited information exists to explain the change in the motivational process (Eccles & Wigfield, 2020; Nolen, 2020). The present study addresses this study gap by focusing on the situational contexts of the learning environment.

Previous person-centered studies with adolescents in the context of the expectancy–value theory have been based on data collected during regular instruction. In teacher-directed instruction, the teacher is responsible for what is taught as well as for specifying the subject matter and methods of learning (Brophy, 2008). Adolescents' autonomy and their ability to gain experience and develop competence are relatively limited insofar as they have only restricted opportunities to shape their own learning (Bassi et al., 2007; Juliani, 2015; Lee & Anderson, 2013; Tomlinson, 1999). Teacher-directed instruction also challenges adolescents' growing needs for autonomy and competence. According to Rosenzweig and Eccles (2019), the conditions of an academic environment can affect students' expectancies and values. In turn, these conditions can negatively impact students' academic functioning.

Self-directed learning has the potential to address this mismatch between adolescents' needs and the learning environment of teacher-directed instruction. Under the self-directed learning approach, adolescents not only take responsibility for their own learning processes but also select their own learning objectives. Adolescents learn in an environment that they have designed themselves. They are guided not only by their self-developed learning objectives, or what they want to learn, but also by the activities that lead to the achievement of those learning objectives, or how they want to learn (Bolhuis & Voeten, 2001; Brookfield, 2009; Knowles, 1975; Tekkol & Demirel, 2018; Van Deur, 2020).

Some variable-oriented studies have shown, in accordance with the claims made above, that adolescents' needs are better met in student-centered learning environments (Schweder & Raufelder, 2019, 2021a; Schweder, Raufelder, Kulakow, et al., 2019; Schweder, Raufelder, Wulff, 2022). A variable-oriented modeling approach ignores issues that result primarily from individuals' heterogeneity. A person-centered data interpretation assumes that individuals react on the basis of different item-response patterns. Additionally, longitudinal person-centered modeling approaches—which are characterized by autoregressive components—provide insights into the change that occurs within individuals' item-response patterns over time. In turn, this information deepens the understanding of the effects of interventions, enabling interpretations to address the issues arising from heterogeneity. To date, no person-oriented study within the framework of the situated expectancy–value theory has investigated adolescents' reactions to a self-directed learning extension included in the regular curriculum, nor has any study analyzed the consequences of shifting from teacher-directed instruction to self-directed learning.

The results of such research would be of high practical relevance for schools. They would deepen educators' understanding of whether even brief periods of self-directed learning in lessons that otherwise consist of teacher-directed instruction could have positive effects on adolescents' success expectations and task values. Therefore, to address these issues, the present study investigates the following hypotheses:

1.3 | Hypotheses

H1: Following the previous person-oriented studies conducted in the context of the expectancy–value theory, we hypothesize that, with regard to motivational beliefs, we can identify both uniform expectancy–value profiles (low, medium, high) and mixed expectancy–value profiles (e.g., low interest but high belief or confidence).

H2: Following the situated expectancy–value theory, we hypothesize that, although profiles are mostly stable over time, they can change. Adolescent students will be more likely to switch to other profiles in response to changing situational contexts (e.g., teacher-directed instruction vs. self-directed learning).

H3: Following the situated expectancy–value theory and the stage-environment fit theory, we hypothesize that adolescent students will switch to more favorable expectancy–value profiles during self-directed learning intervals, because self-directed learning is more need-based than teacher-directed instruction.

2 | METHODS

2.1 | Participants

On the basis of longitudinal measurements conducted over the course of an entire school year, this study collected self-reported questionnaire data from 754 adolescents in Grades 6–9 at four different measurement points ($M_{Age} = 13.56$; SD = 1.2; 49.4% female). The adolescents all attended rural mix-track schools in the federal states of Schleswig-Holstein and Mecklenburg-Western Pomerania, Germany. The criterion that determined schools' eligibility to participate in this investigation was the fact that they occasionally expanded teacher-directed instruction to provide space for self-directed learning on the basis of an equal self-directed learning process (see Figures 1–2). We observed the implementation of self-directed learning intervals to ensure their consistency. The four measurement points were spread across the entire school year. At the first measurement point (T1), we gathered data during teacher-directed instruction sessions in adolescents' favorite subjects. These subjects were most often linked to those that adolescents would later study during the first self-directed learning interval. At the second measurement point (T2), we gathered data during the first self-directed learning interval. During this interval, the adolescents studied a subject closely aligned to one in which they had previously received instruction. At the third measurement point (T3), located after the first self-directed learning interval, we gathered data about adolescents' perceptions during teacher-directed instruction sessions in their favorite subjects. At the fourth measurement point (T4), we gathered data during a second self-directed learning interval. For an overview of this process (see Figure 1).

The curriculum examined in this study means that, during self-directed learning intervals, students pursue a topic that can be assigned to a subject that they prefer. In this study, the preferred subject is labeled as "favorite subject." Using this feature of the curriculum, schools promote individuals' interests not only in a particular topic but also in related subjects. Additionally, a subject serves as a bridge to a subject teacher, who accompanies individual students' self-directed learning intervals and presents the results in the classroom after the completion of a self-directed learning phase. Due to the uniqueness of the curriculum studied, no single subject-specific domain has been examined in terms of self-directed learning extensions' impact. Instead, we have examined a spectrum of teaching domains. Because of our sample's nature, we have student statements that refer to eight different subjects ($n = 42$ [physics], $n = 37$ [math], $n = 67$ [biology], $n = 179$ [arts and language], $n = 54$ [chemistry], $n = 213$ [history], $n = 79$ [social science and geography], $n = 83$ [sports]].

After the Schleswig–Holstein Ministry of Education and Science and the Mecklenburg-Western Pomeranian Ministry of Education, Science, and Culture approved this investigation, parents and adolescents were informed that participation in the study would be voluntary and that all gathered information would be securely stored. Parents, students, and school administrators were informed that the data collection procedure would be conducted in accordance with German data protection laws as well as with the American Psychological Association's (2002) ethical guidelines for psychologists. Due to German privacy protection laws, it was impossible to gather data concerning the participants' socioeconomic backgrounds. With respect to the small proportions of people with migrant backgrounds (from countries outside of Germany) currently living in Schleswig–Holstein (6.3%) or Mecklenburg-Western Pomerania (4.3%; Statistical Office of the Federation and Provinces, 2011), this investigation did not consider background information on migration.

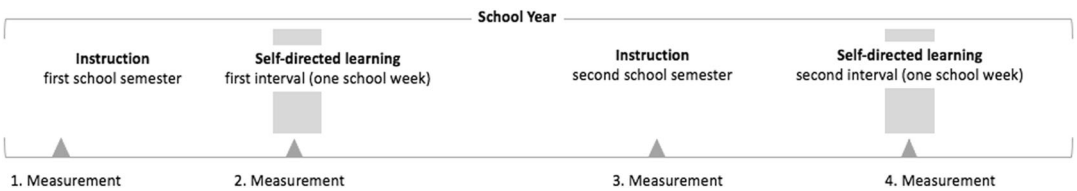

FIGURE 1 Overview to the structure of the curriculum and the measurement points note. The first measurement was held during teacher-directed instruction (TDI) before the self-directed learning interval (SDL) started (end of October), the second measurement was held during the first SDL (2 weeks later after T1; mid of November), the third measurement was held during TDI before the second SDL started (3 months later after T2; mid of February), the fourth measurement was held during the second SDL (2 weeks later after T3; beginning of March).

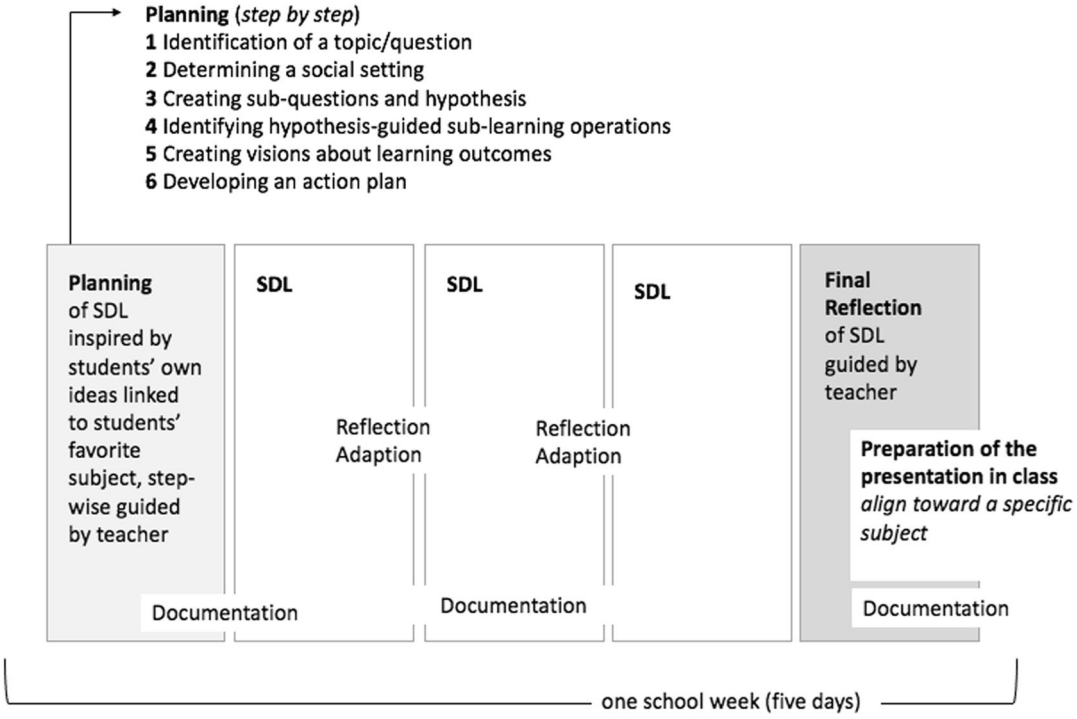

FIGURE 2 Overview to the structure of one self-directed learning interval

2.2 | Measures

Success expectancy was measured using a four-item scale (for items, see Table 8), which was part of a survey of the Program of International Student Assessment (PISA), which has been validated for German students (Artelt et al., 2004). The adolescents responded using a 4-point Likert scale (1 = *not true at all*; 4 = *completely true*).

Intrinsic value (interest) was measured via a five-item subscale validated for German students. As in the study titled "Educational courses and psychosocial development in adolescence" (Baumert et al., 1997), this scale of interest integrates indicators to gather information about adolescents' emotional and personal valences, as well as the scale of their profiles' self-intentional aspects. The interest construct used in the present study can be understood as an "experience of competence and personal control; feelings of autonomy and self-determination; positive emotional states; and, under optimal circumstances, an experience of flow" (Marsh et al., 2005). The adolescents responded using a 5-point Likert scale (1 = *strongly disagree*; 5 = *strongly agree*; for items, see Table 8). During the first measurement session, they were told to respond to the items according to the subject that they imagined would be the most appropriate topic for the first self-directed learning interval. For example, if adolescents interested in gravitation planned to investigate this topic during the next self-directed learning interval, then they would respond to the scale's indicators on the basis of how they perceived the subject of physics. Adolescents responded similarly to the items during the third measurement session, which occurred after the first self-directed learning interval. Adolescents did not change topics over the course of the school year. Domain-specific information was collected using the approach and the different scales described above. This approach mitigated any biases that could have arisen due to domain specificity.

Effort was measured via a four-item scale (for items, see Table 8), which was part of the questionnaire of the PISA survey validated for German students (Artelt et al., 2004). The adolescents answered the items in a range from 1 (*not true at all*) to 4 (*completely true*).

Utility value was measured via a five-item scale validated by Prenzel et al. (1996). These items were used to collect data concerning the degree of perceived utility value during teacher-directed instruction and self-directed learning (for items, see Table 8). The adolescents answered the items in a range from 1 (*not true at all*) to 4 (*completely true*).

The grades for the subjects in which each student engaged in self-directed learning were gathered from the schools' administrative records. German school grades range from 1 (*very good*) to 6 (*fail*). In this study, grade values were calculated as a mathematical average. They can be understood as a summary of performance data. These values have been reversed to facilitate interpretation by international readers.

2.3 | Analytical strategies

Using Mplus 8.1 and the maximum likelihood and robust maximum estimator, longitudinal confirmatory factor analyses (item measurement invariance over time), latent profile analyses to identify latent profiles at each of the four measurement points (to test H1) and latent transition analyses—which longitudinally investigate the transitions between profiles—were modeled to determine adolescents' expectancy–value profiles across the dissimilar learning conditions over an entire year (to test H2–H3).

2.3.1 | Measurement invariance of the variables

First, to meet the requirements for specifying latent profile analyses and latent transition analyses, an analytical procedure was used to check whether the students always interpreted the measuring instruments in the same way. Using a stepwise procedure, longitudinal confirmatory factor analyses calculated with different restrictions were compared via the χ^2 difference test (Satorra & Bentler, 2001). An unrestricted longitudinal confirmatory factor analysis—which led to the assumption of equal factor structure (configural invariance)—was compared with a longitudinal confirmatory factor analysis that assumed equal factor loadings (metric invariance). This model was compared with a third longitudinal confirmatory factor analysis, which led to the assumption of equal intercepts (scalar invariance). To obtain evidence of scalar measurement invariance—which gives evidence that the selected variables reflect an identical concept over time—the results of the χ^2 difference test should not be significant.

2.3.2 | Latent profile analysis

Second, to test H1, latent profile analyses were conducted to identify the optimal number of latent profiles for each measurement occasion (Vermunt & Magidson, 2002). The latent profile analyses clustered students into profiles on the basis of empirically separate response patterns to factors on the variables that were used to generate the profiles. The evaluation of a distinct number of latent profiles was based on statistical criteria: The Akaike information criterion, the Bayesian information criterion, the sample-size-adjusted Bayesian information criterion, the Vuong-Lo-Mendell-Rubin likelihood ratio test ($p > .05$), adjusted Lo-Mendell-Rubin likelihood ratio tests ($p > .05$), and the bootstrap likelihood ratio test ($p > .05$), the entropy value (>0.70), as well as the group size (>3%). The latent profile analyses with the lowest values for the Akaike information criterion, the Bayesian information criterion, as well as the sample-size-adjusted Bayesian information criterion were preferred (Collins & Lanza, 2010; Tuominen et al., 2020).

2.3.3 | Latent transition analysis

Third, a latent transition analysis was conducted to test H2 and H3. In contrast to a latent profile analysis, a latent transition analysis is extended by structural model components. A latent transition analysis includes autoregressions, wherein the latent variables of the individual measurement points are related to each other. The primary purpose of a latent transition analysis is to uncover transitioning effects over time.

To achieve this purpose, latent transition analyses were specified to investigate not only the best fitting latent profile solution. As this study refers to rapidly changing learning conditions (teacher-directed instruction and self-directed learning), this step's consideration of autoregressive elements checks how many classes interpreted the data in an optimal way at each measurement point and over time. The latent transition analysis's different class solutions were evaluated against each other on the basis of statistical criteria (the Akaike information criterion, the Bayesian information criterion, and the sample-size-adjusted Bayesian information criterion).

2.3.3.1 | *Measurement invariance*

For the purpose of measurement invariance, it was also necessary to test models with different restrictions against each other within a class solution. The unrestricted model assumed that the available data are best interpreted if there are no restrictions on the expression of the mean values per class (continuous parameters) and class sizes (categorial parameters). The first constrained model (the semirestricted model) was used to investigate how the data are better interpreted if the categorial parameters vary but the continuous indicators remain the same. In a third model, both the continuous parameters—which characterize a class—and the categorial parameters (i.e., class size) were restricted. Within this fully restricted model, measurement invariance can be assumed. With a view to an optimal class solution, the model was compared using the Akaike information criterion, the Bayesian information criterion, and the sample-size-adjusted Bayesian information criterion values

when the invariance constraints were specified. Additionally, the different constrained models of one specific class solution were compared using likelihood-ratio tests (Vuong, 1989). A significant p indicates that the more restricted model interprets the data better than the less restricted one. If no restricted model interprets the data better, then it is necessary to report class means and the interpretation thereof at each separate measurement point (Hickendorff et al., 2018).

3 | RESULTS

3.1 | Missing data

The present study had incomplete cases: Time 1 (teacher-directed instruction) 51 (6.69%); Time 2 (self-directed learning) 0%; Time 3 (teacher-directed instruction) 79 (10.37%); Time 4 (self-directed learning) 8 (0.98%). At the first and third measurement time, not all students were able to determine a subject that can be assigned to a topic that they preferred for their learning during self-directed learning. The full information maximum likelihood function was used to impute missing data. This technique diminishes bias in contrast to mean imputation and listwise deletion (Rubin, 1987). An advantage of the full information maximum likelihood-technique is on the one hand, the precision of the parameter estimates and, on the other hand, the maintaining statistical power. It was required that the missing data be fully random according to Little's missing completely at random test ($\chi^2[984] = 1006.98$; $p > .05$).

3.2 | Descriptive statistics

Table 1 reports all the descriptive statistics as well as the intercorrelations between variables and covariates. As reported in Table 2, the bivariate correlations indicated strong associations between the variables of interest. Table 3 reports the results of the longitudinal measurement invariance tests and those of the χ^2 difference tests. Using these tests, it was proven that the students ascribed the same meaning to the applied items over time.

3.3 | Latent profile analysis

To test H1, latent profile analyses were conducted to identify the optimal number of latent profiles for each measurement occasion (Vermunt & Magidson, 2002). According to statistical criteria (Nylund et al., 2007), the four-class solution was preferable at all measurement points (see Table 4).

3.4 | Latent transition analyses

To test H2 and H3, different latent transition analyses were specified. The investigation of the latent transition analyses of the three-, four-, and five-class solutions led to the four-class solution (see Table 5). These analyses verify the best fitting solution (four classes) of the latent profile analyses before. In a next step of testing measurement invariance over time, latent transition analyses within nested models of the four-class solution were tested against each other using likelihood-ratio tests (Vuong, 1989). The test between the unrestricted and semimodel of latent transition analyses showed ($\chi^2[48] = 609.10$, $p < .001$) that the four classes unrestricted model interpreted the data better than the model with equated continuous indicators. In this case—according to Hickendorff et al. (2018)—the means of all classes on each occasion (T1–T4) were reported and interpreted separately (see Table 6).

3.4.1 | Results for Time 1

At the first measurement point (during teacher-directed instruction before the first self-directed learning interval), one profile is described as low. Members of the low profile felt less confident, expressed less intrinsic value (interest) toward and effort in completing their assignment, and perceived their learning to lack utility value. A second profile is described as "medium." All of the variables' means were moderately pronounced. A third profile is described as highly confident, highly interested. Members of this profile consistently showed high averages for expectancy, intrinsic and utility values, and effort. The fourth profile is described as highly confident, hardly interested. Members of this profile expressed mixed perceptions regarding all the variables. On the one hand, they felt confident; on the other hand, they had no interest in the subjects being taught. In terms of effort and utility value, the averages were also between medium and low (see Figure 3). Other studies that

TABLE 1 Means (M), SD, range, skewness, kurtosis and Cronbach's α

	M	SD	Range	Skewness	Kurtosis	α
TDI (T1)						
Expectancy	2.49	0.57	1–4	0.14	−0.31	.72
Interest	3.54	0.79	1–5	−0.61	0.51	.81
Effort	2.63	0.37	1–4	−0.12	−0.13	.76
Utility value	2.21	0.36	1–4	0.57	1.93	.72
SDL (T2)						
Expectancy	2.73	0.60	1–4	−0.07	−0.02	.78
Interest	3.83	0.62	1–5	−0.68	1.06	.75
Effort	2.92	0.46	1–4	−0.34	−0.32	.83
Utility value	2.54	0.52	1–4	−0.07	−0.57	.84
TDI (T3)						
Expectancy	2.58	0.58	1–4	0.05	−0.02	.80
Interest	3.68	0.74	1–5	−0.73	0.94	.78
Effort	2.71	040	1–4	−0.13	−0.25	.78
Utility value	2.29	0.40	1–4	0.24	−0.13	.79
SDL (T4)						
Expectancy	2.76	0.61	1–4	−0.08	−0.07	.78
Interest	3.82	0.69	1–5	−0.66	0.21	.73
Effort	2.96	0.47	1–4	−0.42	−0.27	.84
Utility value	2.56	0.55	1–4	−0.18	−0.56	.85

Abbreviations: SDL, self-directed learning; TDI, teacher-directed instruction.

examined math instruction have previously identified these profiles (Lazarides, Dietrich, et al., 2019; Viljaranta et al., 2016). At T1, 27.6% of the adolescents fell under the low profile; 39.3% under the medium profile; 11.7% under the highly confident, hardly interested profile; and 21.2% under the highly confident, highly interested profile (see Table 6 and Figure 4).

3.4.2 | Results for Time 2

At this point (the first self-directed learning interval), the results showed that the preferred four-class solution no longer allowed for the same interpretation of the four profiles as the first measurement point (during teacher-directed instruction). The highly confident, but hardly interested profile had dissolved to the extent that a new profile arose between the medium profile and the highly confident, highly interested profile. This new profile could be understood as high insofar as adolescents attached to it showed uniformly high average values for all variables. This new profile is described as high insofar as the mean values were higher than in the medium profile, but lower than in the highly confident, highly interested one (see Figure 3). Of the adolescents, 4.6% fell under the low profile; 28.4% under the medium profile; 39.8% under the high profile; and 27% under the highly confident, highly interested profile (see Table 6 and Figure 4).

3.4.3 | Results for Time 3

After the first interval of self-directed learning, during another round of teacher-directed instruction, the profiles that arose under self-directed learning conditions were preserved. Nevertheless, the percentage distribution differed (see Figure 3). Of the adolescents, 5.9% fell under the low profile; 28.2% under the medium profile; 40% under the high profile; and 25.7% under the highly confident, highly interested profile (see Table 6 and Figure 4).

TABLE 2 Bivariate correlations

Variable	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Expectancy T1	.19**	.47**	.30**	.38**	.18**	.21**	.15**	.87**	.25**	.50**	.40**	.39**	.16**	.24**	.18**	.45**	.38**
2. Interest T1		.27**	.33**	.18**	.42**	.31**	.29**	.14**	.77**	.27**	.28**	.23**	.44**	.27**	.23**	.17**	.14**
3. Effort T1			.50*	.39**	.31**	.61**	.39**	.51**	.41**	.87**	.48**	.38**	.26**	.61**	.39**	.42**	.33**
4. Utility value T1				.32**	.26**	.39**	.58**	.42**	.39**	.51**	.89**	.33**	.25**	.39**	.58**	.31**	.25**
5. Expectancy T2					.37**	.62**	.52**	.58*	.18**	.41**	.31**	.87**	.29**	.61**	.54**	.74**	.60**
6. Interest T2						.47**	.42**	.28**	.59**	.33**	.26**	.35**	.82**	.46**	.40**	.40**	.29**
7. Effort T2							.62**	.39**	.41**	.62**	.38**	.59**	.40**	.85**	.53**	.63**	.50**
8. Utility value T2								.37**	.34**	.41**	.59**	.53**	.37**	.59**	.88**	.48**	.38**
9. Expectancy T3									.31**	.60**	.46**	.60**	.20**	.42**	.39**	.47**	.38**
10. Interest T3										.45**	.39**	.27**	.64**	.35**	.23**	.23**	.18**
11. Effort T3											.55**	.39**	.30**	.63**	.41**	.41**	.32**
12. Utility value T3												.32**	.25**	.37**	.59**	.29**	.23**
13. Expectancy T4													.36**	.67**	.57**	.66**	.54**
14. Interest T4														.46**	.36**	.32**	.24**
15. Effort T4															.62**	.55**	.43**
16. Utility value T4																.46**	.35**
17. Grade 1																	.79**
18. Grade 2																	

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

3.4.4 | Results for Time 4

During a second self-directed learning session, the profiles from T2 and T3 were replicated once more, but the percentage distribution of the adolescents once again differed (see Figure 3). Of the adolescents, 4.6% fell under the low; 26% under the medium; 42.8% under the high; and 26.2% under the highly confident, highly interested profile 26.2% (see Table 6 and Figure 4).

3.4.5 | Latent transition probabilities

Table 7 presents the latent transition probabilities of the estimated final latent transition analysis (four classes on each occasion). The transition probabilities describe the patterns of change among adolescents. In addition to the percentage of adolescents in each profile at each measurement point (T1–T4), Figure 4 also shows the percentages of adolescents' transitions between profiles across the four measurement points.

After the first self-directed learning session, most of the adolescents in the low profile transitioned to other profiles. The probability of remaining in the same profile from T1 to T2 was very low (.13). From the first self-directed learning session onward, however, the probability of remaining in a low profile developed from a high probability (.95) to a moderate probability (.75). In other words, the low profile was more stable after the first round of self-directed learning. Across all measurement time points, the adolescents in the medium profile showed a relatively high probability of remaining there (.95 → .98 → .89). From T1 to T2, adolescents showed a 30% probability of remaining in the highly confident, hardly interested profile. Nevertheless, this profile dissolved because the first round of self-directed learning began. The interpretation of the means shows that, in contrast to the value of self-efficacy, the value of interest was no longer low. This change caused the emergence of a new "high" profile. From the first round of self-directed learning onward, adolescents in the high profile showed high probability values (1.00 → .97). The adolescents in the highly confident, highly interested profile displayed high probability values across the period under investigation (.92 → .93 → .93).

TABLE 3 Summary of results for tests of longitudinal measurement invariance and results of the χ^2 difference tests

Model	*df*	χ^2	*p*	CFI	TLI	RMSEA	90% CI	SRMR	Δ*df*	Δχ^2	*p*
Interest											
1. Configural invariance	134	224.10	<.001	0.98	0.97	0.03	(0.02–0.04)	0.04	–	–	–
2. Metric invariance	142	228.75	<.001	0.98	0.97	0.03	(0.02–0.03)	0.05	8	5.32	.72
3. Scalar invariance	153	250.67	<.001	0.98	0.97	0.03	(0.02–0.03)	0.05	11	22.35	.02
4. Partial scalar invariance	152	239.95	<.001	0.98	0.97	0.03	(0.02–0.03)	0.05	10	10.93	.36
Expectancy											
1. Configural invariance	74	113.06	<.001	0.99	0.98	0.03	(0.02–0.04)	0.03	–	–	–
2. Metric invariance	82	121.47	<.001	0.99	0.98	0.03	(0.02–0.04)	0.04	8	7.13	.52
3. Scalar invariance	89	134.69	<.001	0.99	0.98	0.03	(0.02–0.04)	0.04	7	12.62	.08
Effort											
1. Configural invariance	74	194.57	<.001	0.97	0.95	0.05	(0.04–0.05)	0.03	–	–	–
2. Metric invariance	82	199.81	<.001	0.97	0.96	0.04	(0.04–0.05)	0.04	8	6.78	.56
3. Scalar invariance	89	203.02	<.001	0.97	0.96	0.04	(0.03–0.04)	0.04	7	7.36	.39
Utility value											
1. Configural invariance	134	281.79	<.001	0.97	0.95	0.04	(0.03–0.04)	0.04	–	–	–
2. Metric invariance	142	294.02	<.001	0.97	0.95	0.04	(0.03–0.04)	0.04	8	7.14	.79
3. Scalar invariance	153	305.35	<.001	0.98	0.96	0.04	(0.03–0.04)	0.05	11	12.32	.14

Abbreviations: CFI, comparative fit index; CI, confidence interval; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; TLI, Tucker–Lewis index.

4 | DISCUSSION

The present study sought to acquire information regarding the outcomes of learning conditions on adolescents' expectancy–value profiles. It relied on a person-oriented approach situated within the framework of the situated expectancy–value theory of achievement motivation (Eccles & Wigfield, 2020). The four-wave, year-long study obtained and evaluated data related to two different learning approaches: Teacher-directed learning and self-directed learning. The investigation extended the existing empirical variable-oriented findings by using a person-oriented approach. It also examined the effects of a curriculum in which teacher-directed learning and self-directed learning conditions alternated over time.

H1 was partially confirmed insofar as uniform expectancy–value profiles (i.e., low, medium, and high) and a mixed expectancy–value profile (i.e., highly confident, hardly interested) were identified at the first measurement point. This profile structure replicated the findings of previous person-oriented studies of expectancy–value profiles (Lazarides, Dicke, et al., 2019; Lazarides, Dietrich, et al., 2019). Nonetheless, the mixed profile was no longer identified when the teacher-directed learning conditions alternated with self-directed learning conditions at the second measurement point. At that point, another uniform profile was identified, and it persisted for the remainder of the school year. This finding is surprising, because it was assumed that the mixed expectancy–value profile would return after the transition from the first self-directed learning interval to the subsequent teacher-directed learning interval. The disappearance of the mixed profile from the first measurement point (teacher-directed learning) can be explained by the change in learning conditions during self-directed learning (self-set learning objectives, self-created learning paths, self-directed time management, teachers as counselors). This provides evidence that situational conditions affect students' expectancy–value profiles (Dietrich et al., 2019; Eccles & Wigfield, 2020).

The learning circumstances of self-directed learning are better able to satisfy adolescents' needs than those of teacher-directed learning (Benware & Deci, 1984; Ryan & Deci, 2020; Schweder, 2019). Self-directed learning environments encourage adolescents' autonomy and competence by enabling them to pursue their own learning ideas, develop a suitable learning strategy, and take advantage of opportunities to regularly adjust their learning strategy and their goals. In the teacher-directed environment, adolescents pursue learning objectives that are derived primarily from a curriculum, and the teacher provides adolescents with an appropriate learning path. Notably, adolescents in this environment do not benefit

TABLE 4 Information criteria values for different profile solutions for each measurement points

c	AIK	BIC	a. BIC	p_{VLMR}	p_{LMR}	Entropy	BLRT
TDI (T1)							
1	5949.89	5986.53	5961.13	–	–	–	–
2	5589.57	5649.12	5607.87	0.013	0.014	0.629	0.000
3	5369.16	5451.61	5394.46	0.000	0.000	0.790	0.000
4	**5239.42**	**5344.77**	**5271.74**	**0.007**	**0.008**	**0.784**	**0.000**
5	5205.46	5333.72	5244.81	0.321	0.328	0.740	0.000
SDL (T2)							
1	6033.70	6070.73	6045.33	–	–	–	–
2	5314.64	5374.82	5333.54	0.000	0.000	0.736	0.000
3	5109.67	5192.99	5135.84	0.000	0.000	0.741	0.000
4	**5025.63**	**5132.10**	**5059.06**	**0.033**	**0.036**	**0.806**	**0.000**
5	4988.13	5117.76	5028.84	0.001	0.001	0.836	0.000
TDI (T3)							
1	5274.82	5310.824	5285.50	–	–	–	–
2	4741.63	4800.26	4758.99	0.000	0.000	0.723	0.000
3	4606.59	4687.77	4630.62	0.058	0.062	0.742	0.000
4	**4550.85**	**4654.58**	**4581.55**	**0.029**	**0.031**	**0.737**	**0.000**
5	4509.68	4635.97	4547.07	0.793	0.795	0.769	0.000
SDL (T4)							
1	6295.30	6332.33	6306.93	–	–	–	–
2	5535.17	5595.35	5554.07	0.000	0.000	0.758	0.000
3	5314.35	5397.68	5340.52	0.046	0.053	0.763	0.000
4	**5227.54**	**5334.02**	**5260.98**	**0.031**	**0.026**	**0.796**	**0.000**
5	5190.86	5320.49	5231.58	0.024	0.027	0.835	0.000

Note: Values in bold suggest the best-fitting model.

Abbreviations: a.BIC, sample-size-adjusted BIC; AIC, Akaike Information Criterion; BIC, Bayesian Information Criterion; BLRT, Bootstrap likelihood ratio test; c, number of latent profiles in the model; p_{LMR}, adjusted Lo-Mendell-Rubin likelihood ratio tests; p_{VLMR}, Vuong-Lo-Mendell-Rubin ratio test; SDL, self-directed learning; TDI, teacher-directed instruction.

TABLE 5 Model fit statistics of latent transition analysis

	Unrestricted model			Semirestricted model			Fully restricted model		
C	AIC	BIC	a. BIC	AIC	BIC	a. BIC	AIC	BIC	a. BIC
3	19005.327	19394.194	19127.459	19470.892	19693.103	19540.687	19608.272	19786.473	19634.891
4	**18327.923**	**18878.814**	**18500.943**	18934.912	19263.597	19038.142	19010.867	19342.266	19127.846
5	18373.897	18889.827	18602.794	18483.891	18946.827	18629.286	18698.856	18977.142	19033.432

Note: Statistical fit criteria of the final model are printed in bold.

Abbreviations: a.BIC, sample-size-adjusted Bayesian Information Criteria; AIC, Akaike Information Criteria; BIC, Bayesian Information Criteria; C, number of classes in the model.

equally from the learning requirements that are assigned to them (Brophy, 2008; Kramarski, 2018). Therefore, it is reasonable to assume that the needs of adolescents who have advanced prior knowledge of a topic are not sufficiently addressed in teacher-directed learning environments (Kulakow & Raufelder, 2020; Kulakow, 2020; Yeager, Henderson, et al., 2014; Yeager, Lee, et al., 2017).

TABLE 6 Group sizes, means for five class-conditional profiles

Latent profiles	Variables	TDI (T1) n = 208 (27.6%)	SDL (2) n = 35 (4.6%)	TDI (T3) n = 45 (5.9%)	SDL (T4) n = 35 (4.6%)
Low	Expectancy	2.032	1.664	1.714	1.677
	Interest	3.194	3.151	3.030	3.257
	Effort	1.996	1.515	1.624	1.492
	Utility value	1.704	1.507	1.550	1.430
		n = 296 (39.3%)	n = 213 (28.4%)	n = 213 (28.2%)	n = 191 (26%)
Medium	Expectancy	2.476	2.380	2.244	2.3335
	Interest	3.703	3.511	3.188	3.414
	Effort	2.703	2.359	2.193	2.343
	Utility value	2.315	1.937	1.829	1.912
		n = 89 (11.7%)	–	–	–
High confident, hardly interested	Expectancy	3.620	–	–	–
	Interest	2.253	–	–	–
	Effort	2.707	–	–	–
	Utility value	1.974	–	–	–
		–	n = 303 (39.8%)	n = 302 (40%)	n = 322 (42.8%)
High	Expectancy	–	2.711	2.590	2.730
	Interest	–	3.826	3.760	3.811
	Effort	–	3.016	2.794	3.056
	Utility value	–	2.630	2.352	2.647
		n = 161 (21.2%)	n = 203 (27%)	n = 194 (25.7%)	n = 201 (26.2%)
High confident, high interested	Expectancy	3.036	3.298	3.074	3.398
	Interest	4.103	4.292	4.182	4.324
	Effort	3.293	3.618	3.248	3.680
	Utility value	2.838	3.212	2.814	3.268

Abbreviations: SDL, self-directed learning; TDI, teacher-directed instruction.

Notably, the proportion of adolescents allocated to a low profile was significantly higher at the first measurement point than at subsequent measurement points. The number of adolescents in the low profile decreased at the second measurement point, and it did not increase at the third measurement point (which occurred during the teacher-directed instruction that followed the self-directed learning interval). Similarly, the proportion of adolescents in the medium profile group at the first measurement point decreased at the second measurement point. The number of students in this profile group remained consistent at the end of the study. Following the introduction of self-directed learning, the number of students assigned to the high confidence, high interest profile group increased. Despite the reintroduction of teacher-directed instruction, it remained at this higher level for the duration of the study. The mixed profile group disappeared after the first self-directed learning interval, at which point a new uniform characterization profile was identified. This new profile existed between the medium profile group and the high confidence, high interest profile group. These results indicate that the profile membership established in the first self-directed learning interval was maintained and transferred to the subsequent teacher-directed instruction interval.

These findings suggest that adolescents' learning conditions during self-directed learning can unlock their interests and preferences in a subject area. In pursuing their own learning goals, adolescents were able to take advantage of their prior knowledge and build on prior successful learning experiences. They were able to constantly adapt their learning goals and strategies; they could also observe peers' processes and learn from their observations. During self-directed learning intervals, the assigned teachers were available as counselors. They serve as an additional resource available to adolescents. Learning

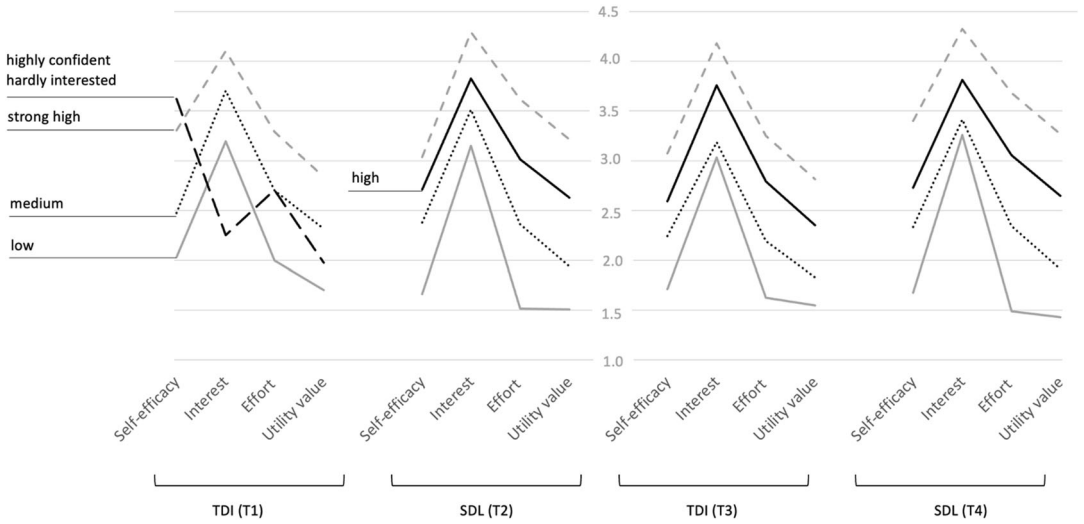

FIGURE 3 Mean scores in terms of adolescents' expectancy-value profiles at each measurement point (T1–T4). SDL, self-directed learning; TDI, teacher-directed instruction.

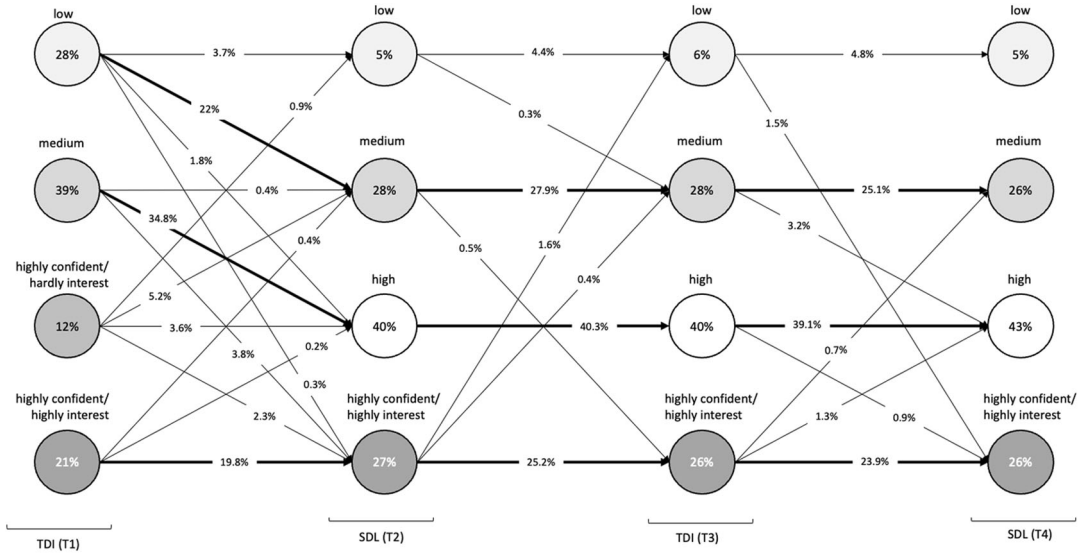

FIGURE 4 Percentage of adolescents in each profile (low, medium, highly confident/hardly interested, highly confident/highly interested, high) at each measurement point (T1–T4) and percentage of adolescents' transitions between the profiles across four measurement points. Bold pathways > 15%; SDL, self-directed learning; TDI, teacher-directed instruction.

conditions in the self-directed learning environment support adolescents' feelings of effectiveness (expectancy [Usher & Pajares, 2009] and intrinsic value [Hulleman & Harackiewicz, 2009], as well as utility value [Hulleman et al., 2010]). Adolescents also benefited from the teacher-directed instruction that followed the self-directed learning interval. In teacher-directed instruction after self-directed learning, the adolescents presented their learning outcomes and expressed appreciation for their peers' processes. The teacher in charge of each subject advised adolescents on the implementation of their learning ideas and supported—afterwards an episode of self-directed learning—adolescents' discussion of their self-generated learning outcomes.

H2 was partially confirmed insofar as the change in learning conditions was associated with a low probability of remaining in the same adolescent profile group, particularly between T1 (teacher-directed instruction) and T2 (first self-directed learning). Nevertheless, adolescents in the high confidence, high interest profile group had a high probability of remaining in it. In other words, students who demonstrated high confidence and high interest in the teacher-directed instruction environment were likely to remain confident and interested in the self-directed learning environment. After the first self-directed learning interval, adolescents' probability of remaining in the same profile group was relatively high for all

TABLE 7 Latent transition probabilities

	Latent profiles SDL (T2)							
	Low		**Medium**		**New profile:High**		**High confident, high interested**	
Latent profiles TDI (T1)	*p*	*n*	*p*	*n*	*p*	*n*	*p*	*n*
Low	.13	28	.01	3	.01	2	.06	13
Medium	.00	–	.80	167	.88	262	.10	29
Highly confident, hardly interested	.08	8	.43	39	.30	26	.19	17
High confident, high interested	.00	–	.03	4	.052	8	.92	148
	Latent profiles TDI (T3)							
Latent profiles SDL (T2)	Low		Medium		High		High confident, high interested	
Low	.95	33	.05	2	.00	–	.00	–
Medium	.00	–	.98	209	.00	–	.02	4
High	.00	–	.00	–	1.00	301	.00	–
High confident, high interested	.06	12	.01	3	.00	–	.93	190
	Latent profiles SDL (T4)							
Latent profiles TDI (T3)	Low		Medium		High		High confident, high interested	
Low	.75	36	.00	–	.0	–	.26	11
Medium	.00	–	.89	188	.11	24	.00	–
High	.00	1	.00	–	.98	293	.02	7
High confident, high interested	.00	–	.03	5	.05	10	.93	179

Abbreviations: SDL, self-directed learning; TDI, teacher-directed instruction.

profile groups. The additional change in learning conditions, which took the form of another teacher-directed instruction interval, did not lead to high latent transition probabilities.

These results indicate that an initial self-directed learning episode could positively initiate transition probabilities to more beneficial patterns. This might encourage adolescents in the hardly interested group to shift to more interested profile groups. One explanation for the high probability of remaining in that profile group after the first self-directed learning interval is that adolescents experienced an increasing amount of emerging interest as a result of interest-driven learning conditions. According to Knogler (2017), individuals who are aware of their interests—and, thus, whose interests are better developed—are more persistent in the face of challenges that arise when working on tasks. These individuals endure frustrations that can occur when completing tasks and they are often confident about achieving their goals. Hidi and Renninger (2006) postulations about adolescents' individual interests and their independence from learning conditions may also explain why the mixed profile did not reappear after first the self-directed learning interval.

H3 was confirmed insofar as a new, more favorable expectancy–value profile emerged in later intervals to replace the undetectable mixed expectancy–value profile. In this new profile group, adolescents who perceived themselves as confident also ranked highly in the other parameters: interest (intrinsic value), utility value, and effort. Additionally, the number of adolescents in favorable profile groups increased over time. These findings suggest that self-directed learning conditions are focused on adolescents' needs and that they positively affect adolescents' success expectancies and task values. The continuation of a positive trend even after the self-directed learning interval indicates that adolescents were able to continue to adapt their learning to their needs during the teacher-directed instruction interval. This suggests the existence of a sustained favorable expectancy–value profile group.

4.1 | Implications

The results of the present work support the situated expectancy–value theory (Eccles & Wigfield, 2020), because the onset of other learning conditions changed adolescents' expectancy–value profiles. There is evidence that the increased adaptivity to

TABLE 8 Full scale for each learning context

	TDI	SDL
Item	In the lesson that is connected with my inquiry area in the upcoming SDL	In my SDL
Utility value		
1	… learning is important for my exams.	… learning is important for my exams.
2	… learning is important for my further school years.	… learning is important for my further school years.
3	… learning is important for my future.	… learning is important for my future.
4	… learning is important for my later goals.	… learning is important for my later goals.
5	… learning is important for me personally.	… learning is important for me personally.
Self-efficacy		
1	… I'm certain I can understand the most difficult material presented in readings.	… certain I can understand the most difficult material presented in readings.
2	… I'm confident I can understand the most complex material presented by the teacher.	… I'm confident I can understand the most complex material presented by different sources."
3	… I'm confident I can do an excellent job on assignments and tests.	… I'm confident I can do an excellent job in achieving the goals.
4	… I'm certain I can master the skills being taught.	… I'm certain I can master the skills being required.
Interest		
1	… it is important to me to be good.	… it is important to me to a be good.
2	… I would even give up some of my spare time to learn new things.	… I would even give up some of my spare time to learn new things.
3	… I enjoy working and learning.	… I enjoy working and learning.
4	… is one of the things that is important to me personally.	… is one of the things that is important to me personally.
5	… it sometimes happens that I don't notice time passing.	… it sometimes happens that I don't notice time passing.
Effort		
1	… I work as hard as possible.	… I work as hard as possible.
2	… keep working even if the material is difficult.	… I keep working even if the material is difficult.
3	… I try to do my best to acquire the knowledge and skills taught.	… I try to do my best to acquire the knowledge and skills taught.
4	… I put forth my best effort.	… I put forth my best effort.

Abbreviations: SDL, self-directed learning; TDI, teacher-directed instruction.

adolescents' needs in self-directed learning led to the emergence of more favorable expectancy–value profiles. This finding aligns with numerous results from the stage–environment fit theory reported in the situated expectancy–value theory. Intriguingly, the expectancy–value profiles initiated in the self-directed learning interval remained stable for the rest of the investigation period. This finding indicates that expanded instruction via self-directed learning, which this study examines, has positive consequences for adolescents' expectancy–value profiles. This result carries significant implications for the design of motivational learning conditions and it contributes to the small body of research on self-directed learning in secondary schools. Furthermore, the results indicate that expanded instruction via self-directed learning is critical for adolescents' development of favorable expectancy–value profiles. This is particularly true for adolescents who initially belonged to the mixed profile group. Adolescents who felt effective but uninterested resolved this conflicting relationship after the self-directed learning interval. Adolescents' interest (task value) and self-efficacy (success expectancy), as well as effort were brought into positive relation. Teacher-directed instruction and self-directed learning in concert create learning conditions designed to enhance adolescents' interest and confidence in learning.

The community of teachers within schools that have adopted curricula that include self-directed learning intervals has agreed to reserve 1 week per school semester for a self-directed learning interval (see Figures 1–2). Nonetheless, it is not the teachers who guide adolescents' learning. Instead, students have an entire school week to pursue their own learning objectives in relation to their favorite topics. Depending on the subject in which the topics can be located, the responsible teacher may

be a counselor. Regular schools can implement this method of instruction. The extension of teacher-directed instruction gives adolescents the opportunity to expand their knowledge of their favorite subjects and, possibly, even their other interests.

4.2 | Strengths and limitations

This study's limitations must be taken into account. The fact that all participating schools were located in rural areas reduced the distortions normally expected when schools from both rural and urban areas are investigated. Moreover, this study is not domain-specific, which is of critical importance in terms of the variables that it examines. Domain selection was based on the adolescents' favorite subjects; therefore, the generalizability of the findings to individual subject areas is limited. Future domain-specific studies are needed. Overall, the curriculum is designed to promote students' individual interests while also accounting for the entire spectrum of interests. This may cause the sample group to be more motivated than it would be if the investigations were directed exclusively toward a particular teaching domain.

Notably, this study does not include a control group. Creating a control group would be challenging, because the adolescents pursue different subjects throughout the study. Therefore, a control group could only adequately exist at the beginning of the study. Additionally, this investigation took place exclusively in German schools. An international comparison would be desirable. Finally, the present study is based on students' self-statements, which can lead to distortion (Spector, 2006).

Despite these limitations, the study has several strengths. First, it includes a large sample that is examined over a period of four measurement points. In addition, the intervention succeeded in increasing adolescents' motivation and their interest in a school setting; it thus offered insight into a pre-existing learning arrangement. Furthermore, the investigation produced person-oriented results that focused on the perspective of changing learning conditions. In doing so, it expanded the existing body of empirical research on expectancy–value theory and stage–environment fit theory. Both theories were recently combined into one, the "situated expectancy–value theory." The results of the present study expand the empirical research of that theoretical framework. Expanded instruction via self-directed learning has the potential to boost adolescents' motivation.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data sets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

In Germany, data collection in schools and compliance with ethical guidelines must be approved by the relevant ministries. Accordingly, the present study was approved by the Schleswig-Holstein Ministry of Education and Science and the Mecklenburg-Western Pomeranian Ministry of Education, Science, and Culture. Parents, students, and school administrators give written consent to take part in this study. Permission to reproduce material from other sources and clinical trial registration is not applicable in the current study.

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