Giving Meaning to the Subject: The Influence of Interdisciplinary Interventions on the Subjective Task Values of Biology and PE

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Abstract

Over many years of research, a decline in interest over the school years is repeatedly described. To address this decline, the value of content or a specific subject should be promoted. To increase content relevance, task value interventions can be conducted which are related to the theory of subjective task values by Wigfield & Eccles (2020). These values consist of intrinsic, attainment, and utility value. Due to its constructivist character, interdisciplinary interventions may meet preconditions to promote interest and could initiate situational interest and influence subject-specific values (e.g., utility value). The present study investigates whether and to what extent interdisciplinary interventions in biology and physical education influence the development of interest.

A total of 73 students (mean age = 17.7 years) from four secondary schools took part in a one-day interdisciplinary intervention called "learning through movement," which combined physical education and biology. The intervention was accompanied by a modified quantitative questionnaire based on pre-described subjective task values. Mixed ANOVAs with repeated measures showed that the interdisciplinary intervention positively influenced situational intrinsic and utility values for both physical education and biology. By examining potential interaction effects, it was found that students with a low initial situational interest were positively affected by the intervention. Our study supports the notion that interdisciplinary interventions have an impact on subjective task values in biology and physical education and therefore have the potential to influence interest development, especially for lower interested students.

Keywords

Interdisciplinary Education, Subjective task values, Interest Development, secondary education, students' interest

Introduction

What students learn in class does not always appear to be relevant to them (Tibbetts et al., 2015). It has been repeatedly demonstrated that interest in specific content and even entire school subjects declines throughout a student's school career (Potvin & Hasni, 2014). Science subjects seem to be particularly affected, especially when students transition from primary to secondary school (Höft et al., 2019; Potvin & Hasni, 2014; Tröbst et al., 2016).

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Developing interest in subjects is important, as this is not only strongly associated with current performance factors such as motivation and academic achievement, but also has an impact on later career choice (Schiefele, 2009; Canning & Harackiewicz, 2019). Thus, educators have sought out ways to enhance or prevent the decline of interest over time. To solve the problem, the decline of interest must be understood. One explanation is the sudden shift from a holistic approach in elementary schools to an increasingly specialized subject structure in secondary schools (Tröbst et al., 2016). A holistic approach allows subject matter to be addressed in the context of students' everyday experiences, which increasingly diminishes with specialization as students get older (Tröbst et al., 2016).

Interdisciplinary teaching approaches have a holistic understanding of teaching and offer a way to counteract the decline of interest in secondary schools. However, there are only a few findings that have explored the influence of interdisciplinary teaching on interest. It is common that only science subjects are linked (Labudde, 2014), therefore interdisciplinary interventions using different disciplines should be further investigated to see if they can promote interest development. In the present study, biology and physical education (PE) were combined and examined.

To understand the potential of interdisciplinary education to promote interest, the four-phase model of interest development by Hidi and Renniger (2006) will be explained. They show that a positive attribution to task values is related to the development of interests. The attributed value of a task can also be described by subjective task values (Eccles et al., 1983). Based on this theory, task value interventions were developed to increase utility value. Interdisciplinary interventions overlap with this concept, which is explained in more detail below.

We offered a one-day workshop to local secondary schools to explore the extent to which interdisciplinary interventions influence the assessment of subjective task values and investigate which students (based on initial situational interest) profit the most from this intervention. Data were collected using a questionnaire that measured subjective task values of biology and PE both before and after the interdisciplinary intervention. Data analysis was performed using mixed ANOVAs and paired t-tests.

Interest

Interest is a motivational process and highly relevant in the context of school (Harackiewicz et al., 2016). Various studies show that interests are predictors of academic achievement, which legitimizes and forces the need to examine the construct of "interest" (Harackiewicz et al., 2016; Harackiewicz & Hulleman, 2010; Hattie, 2009). Furthermore, schools are supposed to form interests for students (Krapp, 1998). However, teachers often assume a black and white scenario; that students either have an interest in the subject content, or they do not (Hidi & Renninger, 2006). Interest is anticipated as something subject-bound and fixed. This interpretation is widespread in research, which mainly investigates interest without asking about possible triggering factors such as educational environment, autonomy, or challenging tasks (Renninger et al., 2019; Harackiewicz et al., 2016). The fact that teachers have an influence on interest and are significantly involved in its development seems to be recognized by only a few (Lipstein & Renninger, 2007). This influence becomes obvious when taking a closer look at the

construct of interest and the four developmental stages according to Hidi and Renninger (2006).

The four stages are divided first into immediate but temporary excitement for the object of interest (situational interest) and a long-lasting need to engage with the object (individual Interest) (Harackiewicz et al., 2016). The first two phases can be assigned to situational interest. In the phase "triggered situational interest," a triggering object-bound and mostly externally induced moment of initial interest occurs (Hidi & Renninger, 2006; Renninger et al., 2019). In biology, such an object could be a stimulating experiment that grasps students' attention. If the individual recognizes a value in the triggering moment, which is often supported by external influence, they potentially pursue it. This may result in "maintained situational interest" (Hidi & Renninger, 2006). The teacher might relate the effect of the experiment to an everyday situation, possibly leading to circumstances where the student becomes more engaged with the experiment. Subsequent phases are assigned to individual interest. A transition to the phase "emerging individual interest" only occurs with an ongoing engagement with the object of interest. This is characterized by the value conception and positive attitude towards the object, as well as acquired knowledge about the object (Hidi & Renninger, 2006). In the example, the student might not only conduct the experiment and explain the results, but further explore theoretical aspects of the biological background that might not be directly related to the experiment. This stage is mainly self-generated but often needs support from external sources which could provide additional challenging tasks or mitigate any emerging difficulties (Hidi & Renninger, 2006). If there is an ongoing engagement with the object that does not diminish through potentially encountered problems, "well-developed interest" can be developed (Hidi & Renninger, 2006). The student might follow up with new questions arising from the experiment. To answer these, the student could conduct new experiments, asks experts, or look up necessary information on the Internet. Like "emerging individual interest," engagement is self-generated but can be externally supported (Hidi & Renninger, 2006).

Often used as a synonym, the concept of interest must be distinguished from intrinsic motivation. An interest, unlike intrinsic motivation, describes a state of interrelation between a person and an object (Schiefele, 2009). Interest initiated by an object initially has a temporary situational character and leads to increased attention and curiosity (Schiefele, 2009). This emotional state either decreases when situational interest is not pursued or can be transformed into individual interest, which constitutes an established "affective-evaluative orientation" (Schiefele, 2009, p. 201) of the person. Individual interest is distinguished from situational interest by stability over time and an increased independent engagement with the object. Furthermore, Renninger and Hidi (2002) postulate that individual interest is manifested as a combination of the level of knowledge and the individual's values towards the object. If a person has a low level of knowledge about and attributes low values to the object, this results in low individual interest (Hidi & Renninger, 2006; Schiefele, 2009).

Subjective Task Values

Beside stored knowledge, individual values towards an object mainly influences interest development. These individual values can be described in more detail by subjective task values, which are a part of the expectancy-value model created by Eccles et al. (1983) and

are values that students assign to a task or school subject. These values are important predictors of individual interests (Acee et al., 2018; Tibetts et al., 2015). Their model states that students' academic performance as well as their future plans and course choices depend on their expectation for success and task-specific values. These subjective task values can be divided into four forms: intrinsic value, utility value, attainment value, and cost (Wigfield & Eccles, 2020).

"Intrinsic value" describes the inherent enjoyment of a task or subject (Eccles et al., 1983). This value is often equated with the terms interest or interest value (Steinmayr & Spinath, 2010). If the task value is highly rated, students can spend a long time on a task. Comparing this value with the previously described stages of interest, the situational character of initial interest cannot be described by this task value (Eccles et al., 2015).

The "utility value" of a task describes its importance to achieve a future goal. The task can have a purely functional characteristic and does not have to follow any intrinsic value attribution. For this reason, the subscale has some similarities to extrinsic motivation in Deci and Ryan's self-determination theory (Eccles et al., 1983).

"Attainment value" refers to the importance of being good at a particular task. An important prerequisite is the confirmation of various aspects of the self that are personally perceived as important (social and personal identities). If those are addressed and challenged by the task, the task's attainment value is also highly valued (Wigfield & Eccles, 2020).

The "costs" of a task describe which activities a person must give up and how much effort and time the individual has to invest to accomplish the task (Wigfield & Eccles, 2020).

The subjective task values were converted by Steinmayr and Spinath (2010) into a comparable quantitative instrument, which captures the values in relation to entire school subjects instead of specific tasks. This test instrument will be used in the present study.

Interest Development in Biology and PE

It has been claimed that "school is more likely to be a killer of interest than a developer" (Travers, 1978, p. 128). This holds some truth, as numerous studies indicate a fundamental decline in students' interest over the school years, particularly in the natural sciences (Höft et al., 2019; Potvin & Hasni, 2014; Renninger & Hidi, 2011; Schiefele, 2009). This decline primarily affects the "hard sciences," which includes math, physics, and chemistry, but has also been seen in biology, though this seems to be subject-specific and gender-dependent (Holstermann & Bögeholz, 2007; Löwe, 1987; Prokop et al., 2007; Vlckova et al., 2019; Wegner & Schmiedebach, 2020). An increased interest in higher grades is explained by the possibility to choose school courses (Dietze, 2007; Wegner & Schmiedebach, 2020). Holstermann and Bögeholz (2007) found that female students had a higher interest in human biological topics like epidemics and diseases, while male students showed a higher interest in physics and technology. This gender difference is often only descriptively described and, in most cases, insignificant in biology (Vlckova et al., 2019). Students show a steady interest in practical activities and life-related content in topics like human biology, whereas other topics like botany tend to decrease interest (Gebhard et al., 2017; Holstermann & Bögeholz, 2007; Prokop et al., 2007).

PE seems to be less affected since it is a favorite subject for many students and a subject that many students are interested in (Klenk, 2004; Wydra, 2001). Despite its popularity, interest in PE also decreases over the school years (Bös et al., 2006; Potvin & Hasni, 2014). In addition, the subject's importance declines and is assessed to be less meaningful, especially among female and low achieving students (Bös et al., 2006; Cárcamo, 2012; Gerlach et al., 2006; Opper, 1996).

Effective Interventions

The question arises as to how the general, but also subject-specific, decline in interest can be countered to promote and consolidate individual interest in subjects. One approach is to introduce an intervention that starts with an object of interest and then try to make it more interesting through alternative tasks or methods. However, not every task can be changed in this way; therefore, it is suggested to highlight the subject's or task's value by including an individual's preexisting interest or goal (Tibbetts et al., 2015). This would change the perception of the subject, which may result in increased interest (Tibbetts et al., 2015). This approach is also supported by Schiefele (2009), who summarizes three preconditions that promote interest. First, instruction must be meaningful. Whether by the teacher or the lesson itself, the importance of the subject matter must be emphasized (Schiefele, 2009). Second, the content must be relevant to the student's everyday life and their practical issues. Finally, it should be connected to the existing interests of the students (Schiefele, 2009). These recommendations result in various intervention formats that aim to increase interest.

Task-value Interventions

Following the recommendations by Schiefele (2009), task-value interventions were developed. This format intends to highlight the value of a subject or task in relation to a person's life and possible future goals. These interventions refer to the subject's utility value since it is believed that, unlike the attainment value, the utility value can be changed throughout these interventions (Acee et al., 2018). Nevertheless, the attainment value is also observed in such interventions, as they may affect a student's identity (Johnson & Sinatra, 2013). Task value Interventions can be divided into approaches where value information is externally provided to the students (explanations by the teacher), or where the students are encouraged to independently determine the value of the subject matter themselves. The latter is achieved by various intervention formats, for example, through a written discussion about the object and its relevance to the student's own life. Both forms of interventions lead to an increased utility value of the current task and are therefore also called utility value interventions (Tibetts et al., 2015). It seems that externally induced approaches primarily impact students with an existing interest and might motivate them to further engage with the subject matter (Durik & Harackiewicz, 2007). However, it has been observed that students with particularly low self-esteem and low initial interest benefit when the subject's utility value is self-generated (Canning & Harackiewicz, 2019; Hulleman et al., 2010, Tibbetts et al., 2015).

Interdisciplinary Education

In addition to task-value interventions, interdisciplinary education also focuses on interest-promoting preconditions since it is characterized by a constructivist orientation. The basic idea of moderate constructivism is an

independent and active construction process of new knowledge, which builds on the learners' previous experiences, prior knowledge, and individual interests (Labudde, 2003). As a result, a learning process only takes place in personally relevant contexts. Labudde (2003) states that instruction that situationally connects to students' existing interests and prior knowledge must be interdisciplinary, as new knowledge is constructed independently from existing subjects. Where subject teaching is still criticized by an increased detachment from students' concrete life situations and problems (Bomhard, 2011), interdisciplinary education tries to engage students by keeping their different learning prerequisites and everyday reality in mind (Labudde, 2008). This constructivist approach already provides all the preconditions for promoting interests in the classroom and should also aim to increase a subject's utility value and interest.

Inferring from the previous explanations, interdisciplinary education is characterized by a self-generated approach as students actively construct new knowledge and grasp the relevance of the content themselves. In conjunction with current research findings on task-value interventions (e.g., Tibbetts et al., 2015), this would suggest that interdisciplinary education initiates situational interest rather than stabilizing an existing interest. Consequently, the intervention is expected to primarily benefit students with lower levels of initial interest.

Purpose

This study examines the potential of an interdisciplinary intervention, which combines the subjects of biology and PE, to promote interest and influence subjective task values as it would link the subject matter with students' lives, potential goals, and existing interests. We aim to investigate if the intervention influences the subjective task values of the separate subjects, therefore, the following hypotheses were made:

H1: The utility value of biology is rated higher after the intervention than before the intervention.

H2: The utility value of PE is rated higher after the intervention than before the intervention.

Since the constructivist nature of interdisciplinary interventions encourages students to independently evaluate the value of the single subject for solving a problem question, we assume that the workshop initiates situational interest rather than stabilizing an existing interest. As this cannot be investigated by "intrinsic value" according to Eccles et al. (1983), we specified this construct to capture the intrinsic value of individual subjects and specifically ask about the situational experience of the subject. This allows the construct to be attributed to situational interest according to the model of Hidi and Renninger (2006). We defined this scale as "situational intrinsic value," and hypothesized that:

H3: The situational intrinsic value of biology is rated higher after the intervention than before the intervention.

H4: The situational intrinsic value of PE is rated higher after the intervention than before the intervention.

Preliminary results from task-value interventions suggest that through self-generated engagement with the subject's value in relation to one's life or specific goals, students with low self-esteem/interest in single subjects

will be positively influenced. These assumptions lead to the following hypotheses:

H5: The initial situational intrinsic value of biology represents an interaction effect over the intervention period, regarding the utility value and situational intrinsic value of biology.

H6: The initial situational intrinsic value of PE represents an interaction effect over the intervention period, regarding utility value and situational intrinsic value of PE.

Finally, since the subject's attainment of the subjects depends on personal factors that are not explicitly addressed by the intervention, we assume:

H7: The attainment value of biology will not change throughout the intervention.

H8: The attainment value of PE will not change throughout the intervention.

Method

Sample

A total of four high school courses with 73 students from North Rhine-Westphalia, Germany participated in the intervention (female = 42; mean age = 17.7 years, grades 12-13). The four courses comprised one basic biology course, one advanced biology course, one basic PE course and one advanced PE course. The intervention was requested by biology or PE teachers for secondary school courses. Hence, there was a compulsion to participate in the intervention, although participation in the accompanying study was open to any participating student.

Interdisciplinary Intervention

The interdisciplinary intervention combined biology and PE and was provided in a workshop format that dealt with a practical sports problem. The intervention lasted six hours on one day and was planned and conducted by two people employed by the university. The high school course teacher was present the entire time but had no direct influence on course implementation. The intervention began with three sport practical coordinative exercises that increased in difficulty. In the basic exercise, students were instructed to throw two tennis balls straight up and catch them again. The final exercise was for students to throw the balls in the air, cross their hands, and catch the balls again. This task could only be performed by a few students, leading students to the following question: "Why do we have such a problem with this coordinative task?"

Students split up into groups to explore different brain areas and their role in creating a movement. After a presentation of the individual brain areas, the sensory stimulus path through the brain was pieced together and explained using the example of the initial sports exercise. The challenge with performing the final exercise has to do with the prefrontal cortex, which is responsible for movement planning and accesses already existing movement patterns. However, if no movement pattern is available, as in the beginning exercise, a new movement must be planned. This is mainly influenced by executive functions. After an initial definition of executive functions based on practical examples from everyday school life, students experienced them using various psychological test procedures. Through such cognitive training, new synapses are formed, whereby the brain creates new networks and can adequately react to new challenges in everyday life. Coupling such cognitive procedures with practical sports exercises effectively promotes the formation of new synapses. After referring to the research question, such coordinative exercises were

performed, modified, planned, and related to executive functions. A more detailed description of the intervention can be found in Kramer & Wegner (in Press).

Through understanding and training the body and brain, in addition to the connection to everyday life, the sports club, and school, this interdisciplinary concept obtains a high relevance to everyday life, which potentially increases the value of both individual subjects.

Test-Instrument

Students were given a questionnaire before and after the intervention to measure subjective task-values in a school context (SESSW, Steinmayr & Spinath, 2010). There are three subscales which are related to entire subjects. This was crucial to guarantee the comparability of measured values (Steinmayr & Spinath, 2010). Preliminary results from implementing this instrument indicate a good model fit (Steinmayr & Spinath, 2010). When recording subjective task values, former studies have observed that “costs” are loaded negatively on one of the other subscales (Steinmayr & Spinath, 2010). Therefore, this component is not considered further in the present study.

Based on theoretical assumptions to generate situational interest in an interdisciplinary intervention, the subscale “intrinsic value" was refined. Instead of querying the general intrinsic value attribution, selected items examined the situational component of attributing values (e.g., "biology is interesting" became "the last hours of biology really interested me"). These variables are adapted in accordance with the construct “Interessiertheit” [situational interest] from Wegner (2009) and were renamed “situational intrinsic value” to distinguish it from the original test instrument.

Results

The data were first checked for internal consistencies in the statistical program IBM SPSS Statistics version 27.0, which excluded one variable for further statistical analysis. Reliabilities of the modified test-instrument showed sufficient internal consistencies (see Table 1). We removed one item (Sit_Int_1) from both subjects and at both measurement times to improve reliability. This provided a better model fit in the confirmatory factor analysis.

Subsequently, a confirmatory factor analysis using the extension bundle “lavaan” was conducted to determine the model fit of a theoretically assumed three-dimensional model in comparison to a one-dimensional model using maximum likelihood estimation. Although the course size is rather small to conduct a confirmatory factor analysis, it is used as an indication of whether the modified scales can be used for the survey. In general, three-dimensional models show significantly better fit indices than the one-dimensional models at both measurement points and in both subjects, which justifies the separation of the three subscales (see Table 2).

The Root Mean Square Error of Approximation (RMSEA) and the Tucker Lewis Index (TLI) tend to reject a correct model assumption for a sample smaller size than N = 250 (Hu & Bentler, 1999). Therefore, the Standardized Root Mean Square Residual (SRMR) was used, which proves a good model fit up to a value of 0.08, and the Comparative Fit Index (CFI), which rejects the model assumption below a value of 0.95 (Hu & Bentler, 1999). Throughout all measurement points and subjects, the three-dimensional model was characterized by a significantly

higher model fit. After calculating a difference test of the respective chi-square tests, these also reveal a significantly better model fit in favor of the three-dimensional model (biology t0: $\chi 2 = 138.001$, df = 3, $p < .001$; biology t1: $\chi 2 = 178.476$, df = 3, $p < .001$; PE t0: $\chi 2 = 187.610$, df = 3, $p < .001$; PE t1: $\chi 2 = 242.207$, df = 3, $p < .001$).

To measure the intersubject factor "pre-interest," pre-test results for the subscale "situational intrinsic value" were used to distinguish between two test groups. Since the questionnaire is based on a six-point scale, the mean value of the construct "situational intrinsic value" for both subjects was divided at a value of 3.5. Students were assigned to a "low pre-interest" (value < 3.5) or "high pre-interest" (value > 3.5) subgroup. For biology, this resulted in a division of the sample into n = 47 (low pre-interest) and n = 22 (high pre-interest). In PE, the data split more symmetrically into n = 35 (low pre-interest) and n = 36 (high pre-interest). It should be noted that this procedure evokes the risk of possible ceiling effects in the subgroup "high pre-interest."

The last step was the identification of possible outliers in the subgroups. Two students were identified with deviating data. They were not considered for further analysis.

Analysis of the subjective task values

To test the hypotheses, a repeated measures mixed ANOVA explored both the main effect of the "intervention" and the interaction effect between the factors "intervention" and "pre-interest." The values of the Mauchly test are redundant and are not reported, as there are only two measurement times.

Utility value

For PE, a homogeneity of variances assumed equal variances for t1 (Levene's Test, $p = .539$), but not for t0 (Levene's Test, $p = .040$). However, an ANOVA is stable against violations of variance homogeneity for equal sample sizes (Bortz, 2005). For PE a significant main effect for the factor "intervention" was shown (Repeated Measures ANOVA, $F(1, 69) = 6.72$, $p = .012$, partial $\eta 2 = .089$). The subscales mean score increased after the intervention (t0: M = 4.13, SD = 1.17; t1: M = 4.39, SD = 0.99). In addition, an interaction effect between the factors "intervention" and "pre-interest" was reported ($F(1, 69) = 12.175$, $p = .001$, partial $\eta 2 = .150$). More differentially, the mean of the "low-interest" group increases after the intervention (t0: M = 3.34, SD = 1.07; t1: M = 3.97, SD = 0.92), whereas this decreases in the "high interest" group (M = 4.89, SD = 0.66; M = 4.8, SD = 0.89, respectively, see Figure 1).

For the subscale "utility value" in biology, the Levene's Test showed that equal variances could be assumed (t0: $p = .71$; t1: $p = .116$). A main effect was found for the factor "intervention" (Repeated Measures ANOVA, $F(1, 67) = 6.36$, $p = .014$, partial $\eta 2 = .87$). The subscale score increased significantly over time (t0: M = 3.65, SD = 1.18; t1: M = 3.96, SD = 1.1). No interaction effect between the factors "intervention" and "pre-interest" was found ($F(1, 67) = 1.57$, $p = .215$, partial $\eta 2 = .023$). Hence, the group classification "pre-interest" did not have a significant effect on the result. Mean scores increased slightly more in the "low-interest" group (t0: M = 3.23, SD = 1.09; t1: M = 3.62, SD = 1.09) than in the "high-interest" group (M = 4.55, SD = 0.82; M = 4.68, SD = 0.72, respectively, see Figure 2).

Situational intrinsic value

Looking at the results for PE, homogeneity of the error variances was confirmed by Levene's test (t0: p = .635; t1: p = .819). The mixed ANOVA revealed a main effect for the factor "intervention" ($F(1, 69) = 27.662$, $p < .001$, partial $\eta 2 = .286$). Thereby, the rating of the subscale increased significantly (t0: M = 3.44, SD = 1.24; t1: M = 4.0, SD = 0.98). Furthermore, an interaction effect between the factors "intervention" and "pre-interest" was found ($F(1, 69) = 23.391$, $p < .001$, partial $\eta 2 = .253$). The interaction effect indicates a more important difference for students in the "low pre-interest" group between the measurement points (M = 2.36, SD = 0.66; M = 3.47, SD = 0.88, respectively) than for the "high pre-interest" group (M = 4.48, SD = 0.62; M = 4.53, SD = 0.78, respectively) (see Figure. 2).

The Levene's test for biology confirmed a homogeneity of variances at both measurement points (t0: p = .886; t1: p = .126). The repeated measures mixed ANOVA revealed a main effect for the intervention factor ($F(1, 67) = 14.190$, $p < .001$, partial $\eta 2 = .175$). The mean score in this subscale increased by more than half a rating level (t0: M = 3.03, SD = 1.27; t1: M = 3.69, SD = 1.0). Furthermore, an interaction effect between the factors "intervention" and "pre-interest" was found ($F(1, 67) = 19.183$, $p < .001$, partial $\eta 2 = .223$). The mean of the "low-interest" group increased strongly over the intervention period (t0: M = 2.35, SD = 0.77; t1: M = 3.35, SD = 0.95), while the mean score of the "high interest" group decreased slightly over time (M = 4.48, SD = 0.80; M = 4.41, SD = 0.7, respectively, see Figure 2).

Attainment value

For the last set of hypotheses, a paired-sample t-test was used, as no interaction factor was included.

For the subscale "attainment value" (N = 72), a paired t-test was performed for both subjects. For biology, no significant difference between the two measurement points was found ($t = 0.245$, $p = .807$). Throughout the intervention, the mean value decreased slightly (t0: M = 3.89, SD = 1.43; t1: M = 3.87, SD = 1.25). Congruent to these results, no significant difference can be reported for PE over the intervention ($t = 1.16$, $p = .250$). In comparison to biology, there was a stronger decrease in attainment value (t0: M = 4.77, SD = 1.14; t1: M = 4.65, SD = 1.13).

Discussion

In the present study, the influence of interdisciplinary interventions on subjective task values was investigated. Following the task-value interventions (Tibbetts et al., 2015) and the preconditions for increasing interest according to Schiefele (2009) that are addressed by interdisciplinary interventions (Labudde, 2008), this study hypothesized that the utility value of the individual subjects is positively influenced through the use of an interdisciplinary intervention. This was stated in hypotheses H1 and H2. After calculating the mixed repeated measures ANOVAs, a significant main effect of the factor "intervention" was found for both subjects. Thus, both hypotheses can be confirmed.

Building on these assumptions, the next hypotheses H3 and H4 emerged. According to Schiefele (2009) and the four-phase model of interest development by Hidi and Renninger (2006), interest is significantly influenced by the value an object is given. Since interdisciplinary teaching establishes a connection to students'

lives through a holistic approach and addresses the utility value, the hypotheses were formulated in a way that when the utility value of both subjects increases, situational interest in the subject matter also increases. The repeated measures mixed ANOVAs confirmed this assumption by a significant main effect of "intervention" on the subscale "situational intrinsic value," whereby both hypotheses can be accepted. The study provides evidence that interdisciplinary interventions have an impact on the emergence of new interests. However, this result does not allow any conclusions to be drawn about an actual influence on the students' individual interest. According to the model of Hidi and Renninger (2006), the effect can be attributed to an influence on the first two stages of the development process of interest. However, it can be hypothesized that since utility value was highly rated for both subjects, the development of interest may also lead to a sustained individual interest (Harackiewicz et al., 2016). It is necessary to investigate whether the effects described above also persist in the long term and how individual interest in subjects develops over time.

In the context of the development of situational interest, the group "pre-interest" was examined for both subjects. The main effect of this classification cannot be taken into account in the statistical investigation, since the effect from the subscale "situational intrinsic value" is artificially created. Nevertheless, this grouping allows us to make a statement about the respective students over the intervention period. In three of the four mixed ANOVAs, an interaction effect between the factors "intervention" and "pre-interest" was found. Only for the subject biology, the groups did not influence the described main effect of the subscale "utility value". Looking more closely at the mean values, it can be descriptively observed for both subjects and subscales that the intervention had more of an influence on the low "pre-interest" group than the group of students with a higher initial situational interest. For PE, this can be additionally confirmed by the significant interaction effects from the two ANOVAs. For biology, this statement is statistically supported only for the subscale "situational intrinsic value." However, for the subscale "utility value", a slight tendency in mean values can be observed. These results support Canning and Harackiewicz's (2019) research, in particular, the notion that self-regenerated value beliefs primarily promote students with initially low situational interest. In addition to the potential of promoting less interested students, these results retrospectively characterize the interdisciplinary intervention as a format that encourages independent engagement with the value of an object (Tibbetts et al., 2015). The established hypothesis H6 can be confirmed subsequently by this argument. Hypothesis H5, however, can only be confirmed for the subscale "situational intrinsic value." The tendencies of the mean values in both groups for the subscale "utility value" legitimize an examination of hypothesis H5 in further studies. Furthermore, the results must be cautiously evaluated; dividing the groups into high initial and low initial situational intrinsic value at t0 evokes a group difference that may have an impact on the results. This procedure carries the risk that the situational intrinsic value of the students with a high initial situational interest has little potential to further increase due to a ceiling effect. The subscale "utility value" is rated very high in both subjects by the group with high initial situational interest ($M > 4.5$). Nevertheless, it remains questionable as to where the threshold for a ceiling effect should be. However, it can be inferred from the data that the students with a high situational interest seem to remain interested in the respective

subject. Accordingly, the intervention has no negative influence on the students.

The last hypotheses focused on the subscale "attainment value" of the two subjects. On a theoretical level, no correlation between interdisciplinary interventions and the perceived attainment value of the individual subjects was observed, since this subscale measures the value of the subject in regard to identity traits. The two t-tests performed also do not suggest a correlation. Accordingly, hypotheses H7 and H8 can be accepted. Similar to task value interventions, attainment value is not addressed through interdisciplinary projects (Acee et al., 2018).

Limitations

The results of this study are subject to some limitations. On the one hand, the sample size is not large enough to draw conclusions about the population. Since other factors might influence interest, further data, e.g., regarding the cultural background of the students, should also be taken into account. In addition to the experimental group, a control group should be used in future research to increase the power of the study. Since the survey period was very short, a response bias cannot be excluded. In future surveys, a sufficient interval between survey periods should be ensured.

In terms of design-based research, our results offer tendencies that should be examined in further studies (Euler & Sloane, 2014). The specification of the "intrinsic value" subscale to determine situational interest value resolves a criticism of Eccles' (1983) theory that situational intrinsic value is not taken into account. In the present study, however, the original scale was replaced entirely in favor of "situational intrinsic value." Thus, these results remain situationally valid and only represent conditional assumptions about the development of interest. The classification of groups based on the subscale "situational intrinsic value" at test time t0 should be critically viewed, since this classification leads to an unnatural group difference at test time t0 and bears the risk of ceiling effects. A classification based on a different scale would be recommended. However, this can only be measured by further surveys, which should be conducted in future studies. Additionally, the intervention only lasted one school day, where regular instruction was suspended in favor of the interdisciplinary approach. This circumstance may influence the results since the intervention did not take place in the form of normal school lessons and therefore represents a special feature for the students.

In further studies, long-term effects should be examined. This follows from previous considerations that only situational interest can be examined. The improved utility value of the two subjects is an indication of a long-lasting effect. Furthermore, the group variable should be formed based on an alternative subscale and, in addition to the situational intrinsic value, the intrinsic value should be used to capture individual interest. In addition, a qualitative design could be used to investigate what the students specifically perceive as the utility of the subject and the extent to which they are now more interested in it.

Conclusion

This study demonstrated the effects of an interdisciplinary intervention on subjective task values despite the limitations described above. Thus, this intervention combining biology and PE led to increased utility values of both subjects. Furthermore, a positive influence on situational intrinsic values of the individual subjects could be confirmed, which need to be

examined in further studies. In combination with the described interaction effects, this effect mainly benefits students with an initially low situational intrinsic value. Regarding the described decline in interest over the school years (Höft et al., 2019; Potvin & Hasni, 2014), our results indicate that students with a low level of interest can be positively influenced by such interventions (Canning & Harackiewicz, 2019). The study therefore suggests implementing interdisciplinary lessons which could potentially reveal the importance of subjects for their lives to especially low interested students.

This study examined how parents support their children in developing their literacy skills during COVID-19 school closures in Kano state, Nigeria. We found that parents actively assisted their children in learning how to read. This corroborates the finding of the TEP Center study (2020), which found that most parents are helping their children learn at home. Similar to the TEP Center (2020) study, we found that parents assisted their children to read their books and encouraged them to learn on the radio. Parents in our study believed that their efforts would ensure that the school closures did not negatively impact the literacy development of their children. However, parents believed that school closures would negatively affect the literacy skills of children who did not get educational support during school closures. This would be the case for many children in Nigeria, because most do not have access to remote learning (Amorighoye, 2020; Hussain, 2020; Mayah, 2020) and are waiting for schools to reopen before they start learning (Obiakor & Adeniran, 2020). Our finding that the school closure would likely decrease children's literacy skills aligns with Azevedo (2020), who found that the percentage of children who cannot read and comprehend a simple story or text could increase by 10% in LMICs due to the COVID-19 pandemic.

Despite the effort of the parents in this study to ensure that the literacy skills of their children continued to develop, we found that parents were faced with the challenges of getting textbooks and lack of expertise teaching reading. Also, parents complained that their busy schedules hindered them from helping their children learn to read. This aligns with the findings of other studies that some parents were not teaching their children to learn at home due to time pressures (TEP, 2020). The parents in this study complained that their children got distracted easily when they were learning as they wanted to play while learning, another finding echoing the report from the TEP study (2020). Additionally, parents in our study found that it is difficult to motivate children to learn in isolation. Parents admitted that they did not know whether their children were in fact improving their literacy skills, due to lack of any ongoing assessment.

This study also found unexpected positive perceived outcomes of the pandemic-related school closures, looking beyond traditional academic learning. Parents reported that they were able to instill more discipline in their children and pay more attention to their moral development. The parents said they had more cordial relationships with their children because they spent more time with them. The children had more time to learn how to do activities such as cooking, household chores, and local crafts. As noted above, most of the participating parents were well-educated, on the whole, and mostly middle-class. They greatly valued education. However, parents were also

able to see the positive side of a very trying and stressful period.

Based on these findings, we recommend that the Nigerian government and other relevant educational stakeholders invest more in remote learning platforms so that more children, especially low-income children, will have consistent access to educational programs on radio, internet, and television. The development of a user-friendly, simple literacy assessment that would enable parents to monitor their children's literacy development would be an asset to parents and schools alike, helping to identify students who will need greater support upon school reopening. This would be a useful tool even after the end of the pandemic. In the short term, the Nigerian government should provide funding to parents to purchase textbooks and other instructional materials for home use.

The major limitation of this study is that most of the parents sampled were middle-class and educated. Azubuike et al. (in press) found that parents who have secondary education or less are more likely to say that they do not know how to support their children to learn remotely. Those that have secondary education or less are most likely to be low-income earners. If our sample included more low-socioeconomic status parents, parents' ways of supporting their children's literacy development and their challenges may be different. Further research should be conducted to investigate how low-income parents supported the literacy development of the children during COVID-19 school closures. Also, the parents in this study were interviewed after schools had been closed for two months. If the study were conducted after a longer period of school closure, parent efforts in supporting the literacy development of children may have differed.

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