

Interdisciplinary nutritional education: interventional study on interdisciplinary learning in home economics and English

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Summary

As part of the LEENA research project (Learning in Nutritional Education and Education with a New Task Culture [*Lernen in Ernährungsbildung und Englisch durch neue Aufgabenkultur*]), a quasi-experimental study in 35 classes has been carried out, with a pre-/post- design and control groups. This was intended to investigate the extent to which cooperation between the subjects of home economics and English supported selected aspects of nutritional education in secondary school level 1. The subject of the teaching was the “healthy breakfast”. Analysis of variance was performed in comparison to the control groups; the test group exhibited significantly greater increases in nutritional knowledge and better use of coordinated knowledge in nutrition and English. On the other hand, it was also found that the level of education of the classes influenced the results of the connection test. Once this was incorporated into the calculations, the significance of the intervention was no longer evident

Keywords: nutritional education, interdisciplinary learning, home economics, English, quasi-experimental study

In schools at secondary level 1 in German-speaking Switzerland, most nutritional education is subsumed into home economics. As part of the LEENA research project

(Learning in Nutritional Education and Education with a New Task Culture [*Lernen in Ernährungsbildung und Englisch durch neue Aufgabenkultur*]), it was investigated to what extent nutritional education could be enhanced within home economics and English.

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Introduction and background to the study

Enhancing expertise by coordinating different subjects

The purpose of nutritional education is to help adolescents to develop their own eating and meal habits in an independent, pleasurable and re-

sponsible manner [1]. This is in accordance with the intention of current reforms in the teaching plans in the German-speaking area, as these are aimed at enhancing expertise in everyday life. Since teaching in lower secondary education is traditionally structured along subject lines the question arises whether these aims would not be better served by implementing a higher cooperation between subjects to help learners link knowledge from different domains to solve everyday life problems [2]. Although there is a long tradition of interdisciplinary school teaching, there have hardly been any empirical studies of its effects on students' performance [3]. In this context, the LEENA project investigated the effects of a teaching-based link between home economics and English on the quality of nutritional education. Home economics and English then acted as partner subjects. In German-speaking Switzerland, home economics has been principally responsible for nutritional education in secondary level 1. Cooperation with English gives the opportunity of enhancing the value of nutritional education within the school. Moreover, this cooperation might stimulate adolescents to think about their own eating habits from different perspectives, as well as developing new approaches and intensifying their own knowledge and expertise. In addition, the collaboration bet-

ween the subjects home economics and English within LEENA takes into account adolescents' everyday experience that, as in other areas of science, a great deal of information on nutrition in the media is now published in English. Within LEENA, adolescents will be provided with the necessary knowledge and linguistic expertise on a typical theme for which they need to collect information in a foreign language, to discuss decisions with others or to learn about their daily habits.

This study employed a specific type of connected teaching and learning, known as "subject connection" [4]. In the implementation, the teacher of one subject employed specific signals (see below) to make specific references to the teaching of the partner subject. In the mode of subject connection employed in LEENA, subject structures were retained almost "as usual". It was hoped that this would lead to greater compatibility with school administration and thus to better long-term implementation than is apparently often the case with other forms of interdisciplinary teaching.

Interdisciplinary teaching in the LEENA project

Interdisciplinary teaching in LEENA was implemented with the theme "healthy breakfast". One reason for selecting this theme was linked to the international HBSC study (Health Behavior of School Aged Children) that comprehensively investigated the health-related behavior of 11- to 15-year-olds. This pointed out that Swiss adolescents frequently do without breakfast: only 44 % of 15-year old girls and 50 % of 15-year old boys have breakfast on every school day [5]. This was therefore a central nutritional issue for LEENA to address.

Aside from the temporal connection of the teaching, so-called "prompts" and "links" were used to connect English and home economics:

Prompts are thought-provoking comments which are used to help students specifically to exploit the full potential of their prior knowledge to solve a new problem. There have been extensive psychological and pedagogic studies on the efficiency of prompts [6]. In the context of LEENA, prompts call on students to use their knowledge from another subject in a new context in a productive manner. For example, an English text was read about adolescents in a supermarket, followed by the following prompt: "Study the adolescents' shopping lists, using what you learnt in the last lesson on home economics." [*"Untersuche die Einkaufsliste der Jugendlichen und nutze dazu dein Wissen, das du in der letzten Hauswirtschafts-Lektion erworben hast."*]

The term "link" was developed during the LEENA project and means the initiation of connections that will be helpful in future, particularly in enhancing the learning process in the partner subject. For example, the students in English lessons analyze breakfast in other countries (England, USA, India). The link to this is: "List the foods in English in the nutritional pyramid and clarify any open questions about this during the home economics lesson." [*"Trage die Lebensmittel auf Englisch in die Ernährungspyramide ein und kläre deine offenen Fragen dazu im Hauswirtschaftsunterricht."*]

Prompts and links were incorporat-

ed into the tasks in both subjects. For example, these included preparation of an international breakfast buffet (including English, American and Indian recipes), keeping a breakfast and nutrition diary or providing advice on breakfasts in learning partnerships.

Questions to be answered by the project

The central research questions were as follows:

1. How does the coordinated teaching influence the development of knowledge in each of the subjects?
2. How does the coordinated teaching influence development of coordinated knowledge from both subjects?
3. How motivated are the students with respect to interdisciplinary learning?

Methods

Procedure

In the context of LEENA, the efficiency of the connection with prompts and links was investigated with an intervention study with a treatment group and two control groups (quasi-experimental setting, ca. 4 weeks, 8th school year, between October 2013 and April 2014). The participants included adole-

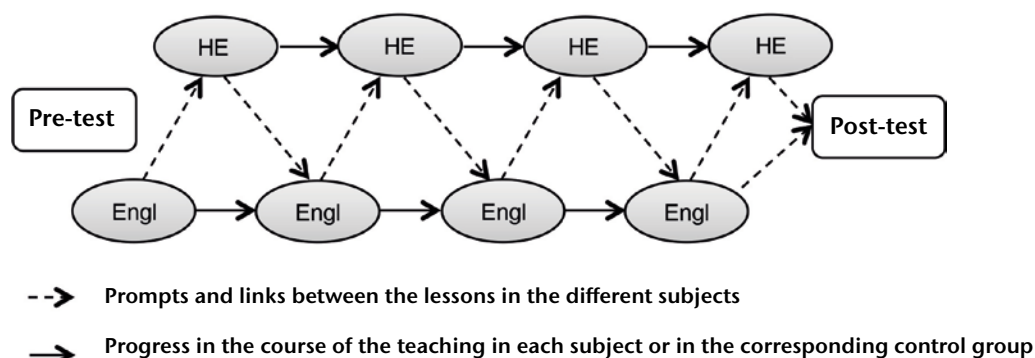


Fig. 1: Study design
Eng = English; HE = home economics

scents from lower secondary schools (n = 87), higher secondary schools (n = 292) and grammar schools (n = 174). The students came from both urban areas (Basel City) and rural areas in North-West Switzerland (Canton Basel-Land, Aargau). The specific teaching concept was as follows: In the treatment group (TG, 18 classes, n = 341), students were given instruction on the theme “healthy breakfast” in both English and home economics by the corresponding teachers within the same period, using prompts and links (see above) in both subjects. ♦ Figure 1 shows the scheme for the plan of the interdisciplinary teaching in the test group.

In the two control groups (CG, 17 classes, n = 212), specific teaching on LEENA was only performed in one of the two subjects. In the CG-Eng (English control group), the English teacher picked out the central theme “healthy breakfast”. The English teaching corresponded to the teaching in the TG. Teaching in home economics was as usual and concentrated on work with the food pyramid. In the CG-HE (control group home economics), only home economics picked out nutritional themes related to the “healthy breakfast”. This teaching corresponded to the teaching in the TG. In the TG-HE, English teaching was as usual; according to the school book, this concentrated on the theme of “healthy living”. Additional time was available in the control groups, due to the lack of the co-ordinations. This time was used for more in-depth discussion of themes within the subject.

The teachers were trained on at least one afternoon and were given a detailed manual with all drafts and materials for teaching; this was also to ensure that the teaching was comparable in the different classes. In addition, the teachers had to document the actual course of their lessons, including inevitable devia-

tions from the plan in the manual. The methodological design integrated both quantitative and quantitative research methods. Increases in subject specific knowledge were measured with a pre-/post-test procedure (t1/t2), with written tests on general nutritional knowledge and on knowledge related to the theme of the “healthy breakfast”; these aimed to measure both increased knowledge in both subjects (research question 1), as well as the connection between the two (research question 2). Analysis of the quantitative data was based on the calculation of two separate two-way analyses of variance with repeated measures (ANOVAs, research question 1), as well as one-way analysis of variance without repeated measures (research question 2). The analyses of variances tested whether the differences between the test results in the groups significantly depended on the intervention. Due to absences, data were not available for all students at each time point. In particular, the number of students from the lower secondary schools dropped to such an extent that they had to be excluded from the analysis. The analyses of the connection test were performed with n = 416, and the analyses of the pre- and post-test with n = 380 persons.

At the end of the study, the students’ motivation (research question 3) was recorded with a questionnaire with four half-open questions and then qualitatively analyzed. For reasons of space, only the quantitative results on research questions 1) und 2) will be discussed here, and will be restricted to issues of nutritional education. Other results from the project have been published elsewhere [7, 8].

Tests

In so far as possible in this research project, we had recourse to available and established tests. Nutritional knowledge was investigated on the

basis of the Nutritional Knowledge Test (NKT), as shortened in accordance with various recommendations and as adapted to the situation in Switzerland and to the theme of breakfast [9, 10]. As a consequence, the test only recorded a single aspect of nutritional expertise, namely applied knowledge. This test was used before and after the intervention (research question 1).

After the intervention, it was also recorded to what extent the students were capable of coordinating what they had learnt in nutritional education and English. This employed a connection test with two tasks that had been developed specifically for LEENA in the project group (research group 2). The test included the task of providing a fictional female adolescent with specific morning habits and food preferences with realistic and personal tips in English for her breakfast.

Results of the quantitative investigation

Pre-/Post-test: Practical nutritional knowledge

♦ Table 1 shows the mean results (\bar{x}) and the standard deviation (SD) of TG, CG-HE and CG-Eng for the test on practical nutritional knowledge at the two time points of measurement that were approx. 5 weeks apart.

In order to test whether the changes in the means (♦ Table 1) between the two time points of measurement were significant, an analysis of variance of the pre- and post-test was performed. This indicated that the intervention triggered a significant effect in nutrition (= treatment effect). The sum of the squares (SSQ) of the factor “group membership” was 148.57 ($p \leq 0.001$), which indicated that there was a significant difference between at least two of the three groups (TG, CG-Eng, CG-HE) with respect to the test perfor-

Test on Nutrition				
	\bar{x}_{t1}	SD	\bar{x}_{t2}	SD
TG	11.0	2.9	12.2	3.9
CG-HE	10.5	12.2	11.3	3.7
CG-Eng	10.0	2.5	9.6	2.7
Total	10.8	2.9	11.6	3.8

Tab. 1: Mean test performance on nutrition at t1 and t2 by group

Eng = English; HE = home economics; CG = control group; SD = standard deviation; TG = treatment group; \bar{x} = mean

mance and that this was caused by the intervention. As it was still not clear which of the two groups caused the significant difference, a post hoc Tukey's test was performed. With this test, it was then possible to identify the affected groups: This showed that the values of the TG differed significantly from the values of the CG-Eng, but not from the values of the CG-HE (TG > CG-Eng, $p \leq 0.001$; TG vs. CG-HE, $p = 0.112$; CG-Eng vs. CG-HE, $p = 0.054$).

In addition, the results of the test on nutritional knowledge showed that there was a significant interaction between the treatment and the time point of measurement. This shows that not only do the three groups differ with respect to their performance, but also that

there were differences in how this changed over time. This is shown in ♦ Figure 2: The TG and CG-HE exhibited higher mean values than the CG-Eng – at both time points. If the different time points are considered (t1 and t2), it is found that there is a slight increase in TG and CG-HE (♦ Figure 3). In contrast, the values for CG-Eng fell between t1 and t2. However, the teaching had a favorable effect in the TG and TG-HE.

Connection test: Development of coordinated knowledge

♦ Table 2 shows the mean values and standard deviations for the results of the connection test in the three groups. Analysis of variance was also performed to test the significance of the results of the connec-

tion test. Here too there was a significant treatment effect. As can be seen in ♦ Figure 4, the TG exhibited a significantly higher mean value in the test than the two CGs (TG > CG-Eng, $p = 0.002$; TG > CG-HE, $p = 0.013$).

It should however be noted that this significant effect vanished when the level of education of the classes was included in the calculation (QSS = 69.072, $p = 0.554$) – whereas the level of education had a significant effect on the results (QSS = 1067.644, $p \leq 0.001$).

Discussion

As a result of the interdisciplinary teaching of English and home economics in the TG and in the teaching on the theme of “healthy breakfast” in the CG-HE, students could extend their knowledge of nutrition (research question 1). This effect was predominantly in the TG, but was also observed in the CG-HE. However, the nutritional tests in the CG-Eng gave surprising or inconsistent results on this research question: The decrease in nutritional knowledge between the pre- and post-test is surprising, as the normal adolescent learning curve alone should have led

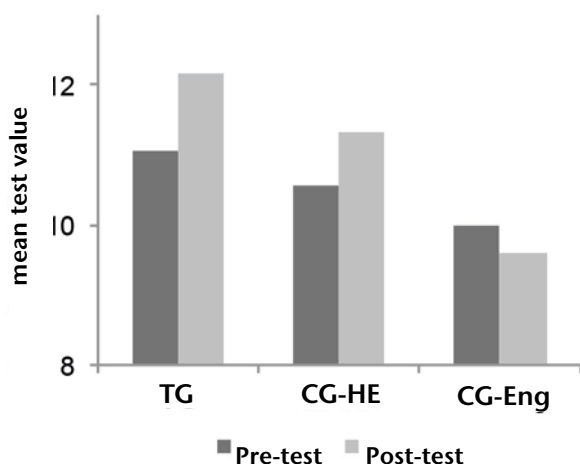


Fig. 2: Results of the test on applied nutritional knowledge by group

Eng = English; HE = home economics; CG = control group; TG = treatment group

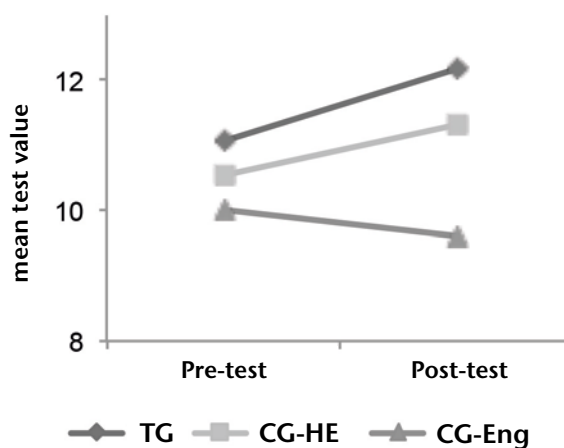


Fig. 3: Results of the test on applied nutritional knowledge by time point

Eng = English; HE = home economics; CG = control group; TG = treatment group

Connection test		
	\bar{x}	SD
TG	22.5	8.0
CG-HE	19.8	7.8
CG-Eng	18.7	7.3
Total	21.4	8.0

Tab. 2: Mean test performances in the connection test

Eng = English; HE = home economics; CG = control group; SD = standard deviation; TG = treatment group; \bar{x} = mean

to an improvement in the values. We think that this decrease is linked to the methods used in LEENA. The learners in the CG-Eng were informed that they were taking part in a study in the CG-Eng and that all tests were performed as part of English teaching. For this reason, it must have been difficult for the students to understand why they also had to answer questions about nutrition. Even in the pre-test, they were less motivated and performed

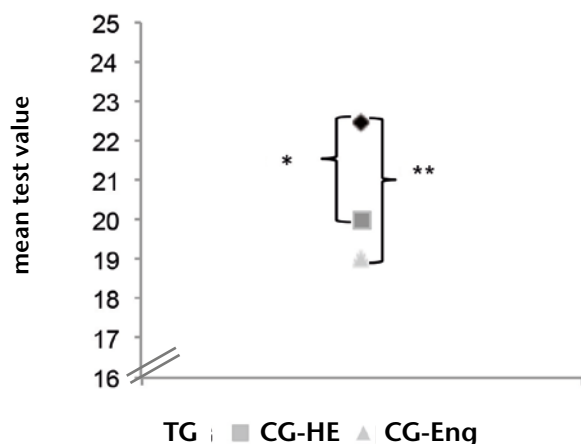


Fig. 4: Results of the connection test [10]

Level of significance * $p \leq 0.05$; ** $p \leq 0.01$

Eng = English; HE = home economics; CG = control group; TG = treatment group

worse than the TG and CG-HE. The poor results in the post-test were also probably due to the lack of motivation. This was confirmed by the members of the study team who performed the tests. They reported that the students in the CG-

Eng were careless when answering the tests and sometimes had to be admonished to work thoroughly. Moreover, from the perspective of the researchers the test used for nutritional education was, in retrospective, unsatisfactory, as the adequately tested instruments were solely related to knowledge. Even if the NKT was adapted to concentrate on applied knowledge, this test is incapable of detecting hands-on experiences or aesthetic aspects of nutritional expertise [11, 12].

In addition, when interpreting the results from the CG-Eng one should keep in mind that the theme "healthy breakfast" was only discussed during English lessons with these learners. The lessons in home economics did not have a specific focus. Thus, the expertise of the home economics teachers on the theme of breakfast was not exploited. Although the English teachers in the CG-Eng had been trained in this subject, it is possibly that some questions remained unanswered. Thus, it should be emphasized that there seems to be no automatic increase in knowledge if nutritional topics are studied under other subjects. The responsible teachers must have comprehensive content related knowledge of the subject and must be willing to allow enough time to discuss the themes during lessons.

With regards to the results of the connection test it was found that learners in the TG, using prompts and links, coordinated what they had learnt in the two subjects significantly better than the learners in the control groups. They were successful in building up an integrated pool of knowledge, which was greater than the sum of the two individual subjects (research question 2). At first glance, it may seem as though these findings were a result of the TG's higher baseline values in t1 (◆ Figure 2) in comparison to the pre-test values of CG-HE and CG-Eng. But even if the TG started with an advantage in knowledge, the

pre-/post-test design demonstrated that they not only maintained this advantage during treatment, but even increased it relative to the control groups. Thus, the treatment was capable of improving not only the nutritional knowledge, but also the coordinated knowledge of the TG – although these two aspects are closely linked.

However, the effect of treatment in the present sample appears to be highly dependent on the level of education of the participating classes (higher secondary or grammar school). As soon as the level of education was controlled for in the calculation, the significant effect of the treatment was no longer evident. In the connection test, grammar school students did consistently better than those in the lower educational level, unrelated to whether they were in the TG or in the CG. It should not be forgotten that a higher level of education was not necessarily accompanied by a higher level of nutritional knowledge, as shown in the subsequent analysis of the results of the pre- and post-tests. The high level of significance of the level of education in the connection test indicates that grammar school students might have been capable of linking the teaching in two different subjects, even without support from prompts and links. However, more research is needed before reliable conclusions can be drawn about these processes.

Aside from the aforementioned points, the remaining question is if and how the performance-enhancing effects found for the intervention used in LEENA can be further increased for future implementations in the field of nutritional education. One reason for the somehow lower results in some classes can be found in the reports of the HE teachers. They show that the teachers sometimes had considerable organizational problems when performing the treatment: loss of teaching periods, students' illnesses,

etc. But outside the research setting they would have more scope to remedy these problems. An additional challenge for home economics was the fact that many of the teaching or connection tasks within the LEENA project did not correspond to the traditional way of teaching in this subject, which normally emphasize on practical tasks [13]. As the intention was to coordinate the teaching with prompts and links and to make the two subjects participate to the same extent in building up a shared pool of knowledge, teaching in home economics during the intervention did not concentrate as much as usual on the practical preparation of meals or dishes. As a result, the specific strengths of this subject, e.g. action/orientated learning, may not have been fully exploited during this project. Moreover, it became clear in the course of LEENA that one of the most important goals for subject-related research should be to construct valid tests for the comprehensive performance assessment of nutritional expertise (see above).

Outlook

Bearing in mind the aim of developing teaching and tasks, LEENA is an encouragement to generate interdisciplinary teaching units, to test different settings and to demonstrate their effects empirically. In this way, nutritional education could become better established in general schools and the development of interdisciplinary expertise would be supported.

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