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MUCH MORE THAN OLD WINE IN NEW SKINS: STUDENTS' AND ADULTS' KNOWLEDGE ON GRAPEVINE AND VINEYARDS AS A STARTING POINT FOR NEW TOPICS IN SCHOOL

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Abstract. *Young people continually lose contact to their natural surroundings and agriculture. As school is one of young people's main source of knowledge it should bring students and nature back together, by using agricultural examples. This research examines German students' and adults' knowledge on plant biological basics and viticulture choosing grapevine as an agricultural example of plants. It was undertaken as a paper-and-pencil test with participants of different ages and from different educational backgrounds. The results reveal the weaknesses of participants' knowledge concerning botanical as well as viticultural aspects. Additionally, the results show a positive correlation between their age and their knowledge on viticulture. Thus, it shows the chance given by developing new teaching material meeting curriculum requirements, modern didactical approaches and the attempt of reconnecting young people with their agricultural surroundings. By using the example of grapevine a local and culturally important agricultural plant is chosen as a representative of different phenomena of botany as well as steps of food processing.*

Keywords: *biology curriculum, science education, sustainability education, knowledge on grapevine, botany and viticulture.*

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Introduction

In days of globalization, climatic changes and a continuous loss of species the awareness of these phenomena is the inevitable pre-condition to meet upcoming problems and dangers. It is by now a commonly accepted fact that society should increase taking care for the environment, focus on renewable energies and teach environmental sustainability and carrying capacity (Bonar, Fife & Bonar, 2016). In contrast to these aims, society, especially the younger part, is increasingly alienated from nature (Brämer, 2006; Hesse & Lumer, 2000). As an example it may be observed that children lack a basic knowledge of species (Bebbington, 2005, Frančovičová & Prokop, 2011). Even adults show significant deficits on their knowledge of species (Shipman & Boster, 2008). Hesse and Lumer (2000) demonstrated with their research that, depending on their educational background, young adults were able to identify less than half of the presented leaves of commonly known trees.

The ignorance of species is considerably dominant for plants. This may be explained by the phenomenon of plant blindness (Wandersee & Schussler, 1999). According to this theory "plants are often overlooked and neglected" (Wandersee & Schussler, 1999), since "people typically know less about plants", "the homogeneity of their green leaves and stems does not serve to visually label [plants] or make them pop out chromatically from their background", they "appear relatively stationary" and represent the "nonthreatening elements of an ecosystem" (Wandersee & Schussler, 1999). Dillon and colleagues (2005), Holstermann & Bögeholz (2007) as well as Bickel & Bögeholz (2013) point out that this is not only true for children's natural environment but also for agriculture. "Agricultural organizations realized a lack of knowledge and understanding of agriculture and agricultural processes" (Hubert et al., 2000, p. 526). Several studies have shown that people's interest in and knowledge about crops and other agricultural goods is very poor (Brämer, 2006; Bickel & Bögeholz, 2013; Fritsch & Dreesmann, 2015; Holstermann & Bögeholz, 2007; Hubert, Frank & Igo, 2000). Still it might be observed that plants which are culturally important or have a direct impact on people's lives (e. g. edibility, nativity) are far better known than others (Fritsch & Dreesmann, 2015; Prokop & Frančovičová, 2014, Prokop, Majerčíková & Vyoralová, 2016; Robinson, Inger & Gaston, 2016).

Problem of Research

Knowledge on species and biological topics is a fundamental basic to understand nature and foster the aim of sustainability. Hence, the reconnection of people and nature is important. A reason therefore is that people may only protect what they know (Wandersee & Schussler, 1999), since "[values] for wildlife are connected with knowledge and experience" (Sammet, Andres & Dreesmann, 2015, p. 248). Kellert (1985), Zubke & Mayer (2003), and Reimer and colleagues (2014) have found out that students with a deeper knowledge on biology and biodiversity have an affirmative attitude towards species. This positive attitude and knowledge form the primary condition of sustainable thinking, since "it [is] determined that students of all ages, if presented information in a systematic manner, would become better decision-making adults in matters relating to agriculture and the environment" (Hubert et al., 2000, p. 527 f.). Agriculture may serve as a link between people and nature as it influences daily life directly and indirectly. Some studies revealed that daily life influences students' knowledge (Natarajan et al., 2002; Partick & Tunnicliffe, 2011) and that plants which have strong connections to students' daily lives are recognized much better than other ones (Fritsch & Dreesmann, 2015; Prokop & Frančovičová, 2014, Prokop, Majerčíková & Vyoralová, 2016). Natarajan and colleagues (2002) found out that sociocultural values and experiences may additionally positively influence students' knowledge.

Research Focus

Knowing the strong influences of (agri-)cultural plants on people's knowledge it becomes interesting to know whether Lindemann-Matthies' (2005) statement that knowledge on plants leads to a higher appreciation is also true the other way round. Consequently, we set up this research, taking grapevine as a highly appreciated and socially influential plant in Germany (Ministerium für Wirtschaft, Verkehr, Landwirtschaft und Weinbau, 2010; Charters, 2006; 316 f.) and measuring people's knowledge on grapevine, its biological basics, grape processing and wine production. Grapevine is a plant which is cultivated on almost every continent (Müller, 2008) and is, e.g. in the United States, not only of agricultural importance, since it covers "one million acres of grape bearing land" (The National Association of American Wineries, 2014). Beside countries which are famous for their grape production like Spain, France or the United States, others like Iran, Romania, Moldova belong to the top fifteen countries worldwide, concerning their vineyard acreage (Wine Institute, 2014). This demonstrates the widespread importance of grapevine and wine to different cultures all over the world. Above that the long tradition of winemaking and therefore, the continuous development of agricultural expertise over hundreds of years, becomes clear by lots of allusions and images used in one of the oldest and most-sold books, the Bible (e.g., Wedding in Cana, John 2:1-11).

This research was undertaken to gather preliminary results on students' knowledge about grapevine and vineyards as a basis for an innovative teaching project. Following the theory of life-long learning (Ainley & Ainley, 2011; Seel, 2012) an accumulation of knowledge should be observed. Unlike typical 'school topics' (e. g. genetics, neurology) people are confronted with facts about grapevine and wine a whole life. This may lead to the proposal of the hypothesis that facts about wine and viticulture are better known by older participants than information about a plant's (grapevine) biology, which is implemented in several curricula (e.g., Ministerium für Bildung, Wissenschaft, Weiterbildung, und Kultur Rheinland Pfalz, 2014; Next Generation Science Standards, 2013; Ministerium für Bildung, Wissenschaft und Weiterbildung Rheinland-Pfalz, 1998).

Therefore the following research questions were set up:

- What do students and adults know about grapevine as a growing plant, its biology and about food processing for wine production?
- Does knowledge correlate with age?
- Does knowledge correlate with formal education (highest degree obtained)?

Methodology of Research

This research was conducted from June to September 2015 in Rhineland-Palatinate, Germany. A paper-and-pencil test collected data quantitatively and qualitatively. The test was divided into three contextual categories: personal aspects, knowledge on grapevine biology (consisting of questions about plant biological and ecological aspects) and knowledge on viticulture.

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Sample of Research

The sample of this research consisted of 365 participants (43.6% male, 1.1% did not offer any information about their sex). As the differences in knowledge depending on participants' age were content of this research, 176 school students as well as 189 adults were part of the sample. School students attended year six to twelve of different types of schools in Germany (Gymnasium, i.e. the highest stratification level within the German school system, secondary schools as well as special schools for handicapped students). 106 (37 students, 69 adults) of the participants were attending or had attended the German 'gymnasiale Oberstufe', while 218 (130 students, 88 adults) had not (yet) (The 'gymnasiale Oberstufe', or 'Oberstufe' for short, are the two last, optional years of school in Germany. They may only be visited in a Gymnasium and comply the requirements for reaching the German 'Abitur', the highest graduation in Germany, which resembles a certificate of aptitude for higher education. More detailed information is available online from the Secretariat of the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany, internet resource given in the references.). The participants of this research had been selected irrespectively of their interest in plants, wine or biology in general. Although participants did not live within a grapevine growing region directly, it was in a daily reachable distance in the federal state of Rhineland-Palatinate, which is famous for its wine production. For measuring their knowledge on grapevine, plant physiology as well as wine and food production, the participants were not given any information on the topic before this research, although they were informed about the research's aim.

Instrument and Procedures

This research was conducted by a paper-and-pencil test following some main principles of questionnaire construction according to construction rules of Porst (2014) and Brace (2004). The questionnaire consisted of 35 items. The participants had to answer with short sentences on open-ended items, with ticking on single-choice questions as well as multiple-choice questions. Closed-ended content items could be answered on a nominal scale. The main parts of the questionnaires for students and adults were constructed equally.

Among the personal aspects were questions about participants' age (item P1), grade (students)/educational level (adults) (P2), gender (P3), and whether they still visited or had already finished school. These aspects were asked for to classify the participants in regard to the research questions. Furthermore, some items asked about former visits to vineyards (e. g. number of visits, company) and their experiences with grapevine in school. All content items of the questionnaire fit into the categories grapevine biology or viticulture (Table 1) and aimed at measuring participants' knowledge on viticulture, wine, grapevine and plants in general. The questions were constructed following the curriculum of science and biology, common topics in the public media as well as cultural transmitted information.

Table 1. Overview over the questionnaire's subcategories and the participants' success.

		Points to be reached	Mean value	Median	SD
Grapevine's biology		14	6.39	7	2.77
Subcategories	Correct use of terminology	5	2.33	2	1.16
	Characteristics of vine	1	0.82	1	0.38
	Interactions with the ecosystem	2	0.47	0	0.57
	Characteristics of vine as a plant	6	2.77	3	1.75
Viticulture		23	10.72	10	4.75
Subcategories	General knowledge	2	1.50	2	0.51
	Correct use of terminology	10	4.44	4	2.72
	Process of wine making	8	3.41	3	1.84
	Food processing	3	1.37	1	0.93

The items of the questionnaire were arranged depending on the question style, irrespectively whether they belonged to the category grapevine biology or viticulture.

A main aspect of the questionnaire was to investigate the correct use of terminology. Reasons therefore lie within the German language, as it may cause some complications for the correct use. The first aspect the questionnaire addressed was the German word 'Traube' (Items Q6 to Q9, also see Table A, Appendix). The German language uses 'Traube' as a layperson's term for 'grape', although the correct meaning of this term is 'bunch of grapes' in viticultural language. The aim of defining this sub-category was to figure out whether school manages to clarify the difference and importance of the correct use of technical terms. The second aspect was the limited use of the word 'Wein', which stands for 'grapevine' and 'wine', respectively. As the meaning of 'wine' seems to be dominant in people's heads, other meanings of 'Wein' were asked for, aiming for characteristics of the plant and itself (Q19, also see Table B, Appendix). Additionally, the questionnaire asked for terminology synonyms in the German language. As there is more than one word for the term 'grapevine', one item analyzed whether people knew about the equivalence of the terms used (Q11, also see Table A, Appendix).

Data Analysis

For detailed data analysis descriptive statistics and statistical tests to answer the research questions were used. Kolmogorov-Smirnov tests revealed a lack of normal distribution of the data. Consequently, Mann-Whitney-U and Kruskall-Wallis tests were used to identify significant differences of the results. Correlations between different variables were analyzed with Spearman's-ρ as coefficient.

For analyzing the open-ended items the answers were categorized primarily based on the category finding process of qualitative content analysis processes following Mayring (2015) and Schreier (2012). Therefore, a coding frame was set up deductively and complemented inductively. The categorization of participants' answers was checked by a second researcher to ensure objectivity. The percentage of agreement between the two researchers was 100%. Participants' knowledge was measured with a knowledge score. Therefore, the given answers were graded with absolute points. The open-ended items were graded with up to two points depending on their complexity level. Partly correct answers were graded with one point. Single-choice questions were graded with one point. Multiple-choice questions were graded with two points for completely correct answers and one point for partly correct answers.

For all types of questions, wrong answers, missing answers as well as invalid answers were graded with 0 points. No penalty points were given.

For a detailed analysis of the data, participants were classified differently depending on the research aim. Therefore, three different classifications were set up: depending on the age of the participants, their scholar status (students/adult) as well as their educational level.

Data analysis was carried out with Microsoft Excel and IBM SPSS Statistics.

Results of Research

Personal Aspects

Numerous participants of the research (71.0%) had already visited a vineyard. Only 9.6% of all participants expressed that they had visited a vineyard with school. Additionally, only 28.8% of the interviewees had dealt with wine, grapevine and vineyards in school before. A percentage of 54.8% clearly expressed that they had not.

An absolute number of 136 participants agreed that they had already heard about the vinegar fly (*Drosophila suzukii*), whereas 226 participants disagreed.

Knowledge

Participants reached a mean score of 47.0% of the reachable points of the questionnaire regarding the complete sample of questions. Similar results where reached in the categories grapevine biology (45.6% success rate) and viticulture (48.0% success rate). For the whole of all questions as well as within the two categories a positive correlation between the number of previous visits in a vineyard and their content knowledge could be observed (Table 2).

Participants who had already visited a vineyard before the research scored significantly higher than those who had not (Mann-Whitney-U test: $U=-9.332$; $p < .001$, $N=359$).

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Table 2. Correlation of number of vineyard visits and success rate.

	N	Spearman-ρ	p
All items	363	0.532	< .001
Vine's biology	350	0.427	< .001
Viticulture	352	0.520	< .001

Note: Correlation is significant since $p < .01$.

Comparing students to adults revealed a significant difference in their success rate (Mann-Whitney-U test: 8026.500, U=-8.273; $p < .001$). As before, this was not only true for the complete sample of questions, but also for the two content categories grapevine biology (Mann-Whitney-U test: 10852.500, U=-5439, $p < .001$) and viticulture (Mann-Whitney-U test: 7800.000, U=-8.613, $p < .001$).

Comparing age to knowledge, the results indicate a positive correlation between these two factors (Spearman-ρ= 0.584, p= .000 < .01, N=358). This correlation is clearly stronger for the category viticulture (Spearman-ρ= 0.603, p= .000 < .01, N=360) than for the category grapevine biology (Spearman-ρ= .385, p= .000 < .01, N=358).

The tendency of increasing knowledge with higher age was also true for knowledge on botanical terminology (Spearman-ρ=0.320, p= .000< .01, N=360). Additionally, the results indicate that people who have visited the 'Oberstufe', i.e. have had more formal education, perform significantly better recognizing and defining botanical terms, than people who have not (Mann-Whitney-U-test: 8946.000, U=-3.422, p= .000< .05). A significant higher score could also be demonstrated for adults compared to students (Mann-Whitney-U-test=11729.000, U=-4.822, $p < .001$). Lowest scores of this sub-category were reached for the item "A bunch of grapes is a small, round fruit." (Q9, mean value: 0.08 of one reachable point).

Items of the sub-category 'interactions with the ecosystem' aimed at the relation between grapevine and an upcoming parasite: the vinegar fly (*Drosophila suzukii*). All in all, participants reached 0.47 of two reachable points within this category and people who had already heard about the vinegar fly scored significantly higher than others (Mann-Whitney-U-test=8744.500, U=-7.896, $p < .001$).

Similar to the other sub-categories a slight tendency of increasing knowledge by a higher age could be observed for the knowledge on the 'characteristics of green plants' (Spearman's-ρ= 0.244, $p < .001$). Participants who (had) experienced biology lessons of the 'Oberstufe' performed significantly better than others (up to 'Oberstufe': mean value= 2.47, H=217; 'Oberstufe' or higher education: mean value: 3.59 of six reachable points, H=106; Mann-Whitney-U-test: 7267.000, U=-5.475, $p < .001$). A closer look at individual items shows a difference of answers between people who were or were not attending the 'Oberstufe' (Figure 1 and 2).

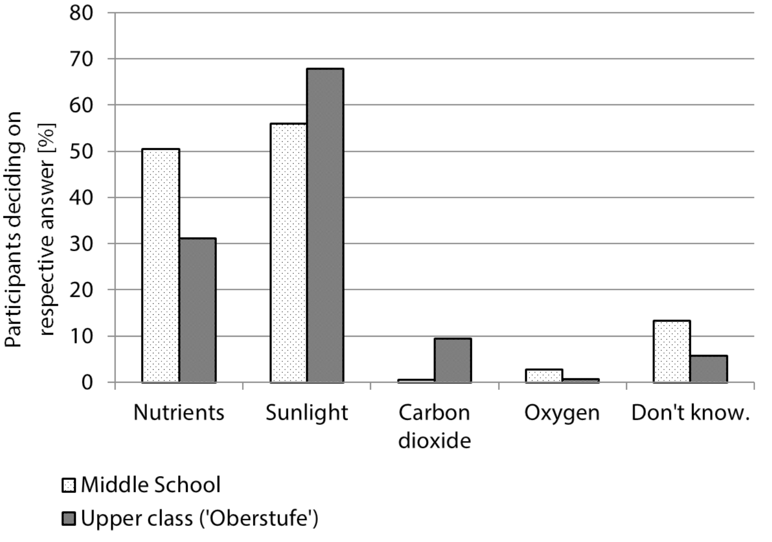

Figure 1: Percentage of students and adults deciding on the respective answering option of item Q23 ('What is vine's main source of energy?') in relation to their formal education.

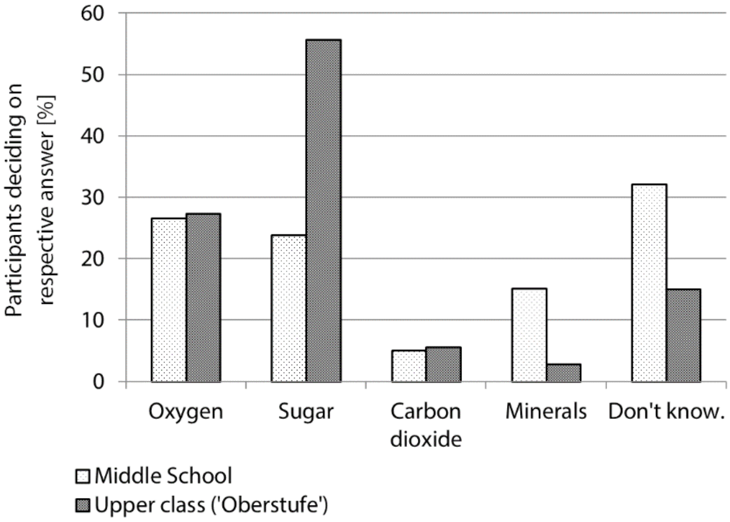

Figure 2: Percentage of students and adults deciding on the respective answering option of item Q24 ('What is, from the perspective of vine, main product of photosynthesis?') in relation to their educational level.

The sub-category 'correct use of terminology' revealed a clear correlation between success rate and age (Spearman's $\rho=0.546$, $p < .001$).

About 88% of the participants recognized grapevine/wine as an alcoholic drink, but only 3.7% selected "Grapevine/Wine is a plant" as (additional) correct answer (Q19).

Discussion

Compared to current research this seems to be the first research focusing on students' and adults' knowledge on grapevine, growing grapevine and processing grapes. The results show that so far grapevine and vineyards are hardly used as topics or out-of-school learning sites. As reasons teachers name too long distances from school (Anderson, Kisiel & Storksdiek, 2006) or a lack of teaching materials meeting the official curriculum requirements and modern didactical approaches (Anderson et al., 2006; Dewitt & Osborne, 2007).

The aim of the research was to find out what people know about agricultural goods which do have large impacts on social lives. The participants of the research reached about half of the reachable points (M = 47%). This shows that school and cultural education could lay a foundation of general knowledge about agricultural plants and food processing. Nevertheless, higher results had been expected in a federal state which claims to be famous for its wine production.

As grapevine and wine have the same spelling in German ("Wein") a connotation of this word was asked for. The data reveal that "Wein" is predominantly thought of as alcoholic drink (Q19: "Grapevine/Wine is …"). Less than four percent chose "a plant" as additional correct answer. This underlines people's loose contact to nature and agriculture (Bickel & Bögeholz, 2013; Brämer, 2006; Holstermann & Bögeholz, 2007; Kellert, 2002) and decrease in knowledge about food processing and foods origin (Hubert et al., 2000).

Differences in Relation to Age and Education

Having a closer look at the results of the survey a significant positive correlation between age of the participants and their knowledge becomes obvious: adults reached higher scores than students. This goes along with the theory of life-long learning (Ainley & Ainley, 2011; Seel, 2012). According to this theory learning is not over by finishing one's educational career. Moreover, school and university lay the foundation of life-long learning. They provide a fundamental knowledge on which people may build further knowledge on the one hand, and teach them several strategies of learning and understanding new facts and principles on the other. The correlation is stronger within the category

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viticulture than in the category grapevine biology (strongest correlation within the sub-category of 'viticulture terminology'). It supports the findings of Dillon, Rickinson, Sanders & Teamey (2005) "that young people's knowledge of how their food is produced and how it gets to their plate seems limited". Additionally, the category of non-consumers is lawfully kept in a distance to wine and its production processes (Bundesministerium für Familie, Senioren, Frauen und Jugend, 2002). Moreover, it might be explained by the stronger cultural impact on older participants within the category viticulture. Consumers inform themselves from "various outside sources" (Dodd, Laverie, Wilcox & Dunhan, 2005) and direct encounters before choosing a certain wine. These experiences accumulate during a lifetime, e.g. on wine festivals, by consuming wine or other societal events like a guided group walk through a vineyard or vinery. Further studies on the origin of participants' knowledge would have to be conducted in order to verify these assumptions. Another reason for a higher correlation in the category of viticulture might be the decreasing interest in biological topics with older age (Prokop, Tuncer & Chudá, 2007). This lack of interest works against developing botanical knowledge, depending on the age of the participants in contrast to other topics like wine consumption, which are felt to be culturally valuable.

Although some basic botanical knowledge is even part of the biological curriculum in lower grades in Germany (two in twelve topic areas, Ministerium für Bildung, Wissenschaft, Weiterbildung und Kultur Rheinland-Pfalz, 2014), plant biology as well as specialized ecosystems, like vineyards, are discussed in detail within the last two, optional years of school. Therefore, the scores of students and adults who had already visited or were visiting the 'Oberstufe' were compared to those who did not. An obvious difference between the two groups could be observed in the sub-category 'characteristics of grapevine as a plant'. The distribution of answers on item Q23 ('What is grapevine's main source of energy?') reveals the clear shift of ideas of plant's nutrition. In contrast to lower class students, who added nutrients as an additional main source of energy, higher classes set their focus on the sunlight. This might be an indicator that biology teachers of higher grades succeeded in emphasizing the outstanding characteristic of green plants: 'catching' sunlight's energy into organic matter. Furthermore, participants visiting the 'Oberstufe' clearly succeeded in identifying glucose as (from the plant's perspective) most important product of photosynthesis (Q24, 'What is, from the perspective of grapevine, the main product of photosynthesis?'). Several post-hoc tests on significant differences showed no knowledge differences between students who visited higher grades and adults. This indicates once more the importance of higher scholar education for the gain of botanical knowledge. In contrast to this, the sub-category 'viticulture terminology' showed clear advantages of adults compared to students, irrespectively their educational status. As mentioned above, a reason might be that a lot of terms and knowledge concerning viticulture are learned by direct contact, which is more common among adults. Still, the correct use of terms, no matter what content field they belong to, is very important and should be trained in school. It is especially important for those terms, which are wrongly used in everyday-language (Q9, 'A bunch of grapes is a small, round fruit.'). The different use of the same term in everyday and technical language may confuse students (Jacobs, 1989), which is proven as correct by the results on terminology knowledge.

The Importance of Previous Knowledge and Prior Experiences

According to the theory of cumulative learning (Seel, 2012) knowledge is constructed and learning new facts is always based on prior knowledge or experiences and connected to these (Bransford et al., 2000; Falk & Dierking 2000). The present results support these theories as they indicate a significant difference between people who have already been and those who have not been to a vineyard yet. Additionally, participants who had already heard about the vinegar fly in any context, scored significantly higher for the sub-category 'interactions with the ecosystem' than those who had not.

Implications for Further Teaching

The results show that in the case of Rhineland-Palatinate out-of-school learning at prominent examples like vineyards is hardly used by now. New teaching projects combining curriculum requirements, students' interests and regional importance while using agricultural examples may meet this problem. Thus, they enable students and teachers to explore vineyards as anthropogenic ecosystems, discover facets of plants and their biology by looking at a typical representative, grapevine, and learn different aspects of its developmental stages. These direct experiences with nature might positively influence learning compared to theoretical teaching units (Prokop, Majerčiková & Vyaoralová, 2016) Especially in times, in which students spend less time directly confronted with nature (Moss, 2012), teaching the respective contents might change their attitudes towards food (Lineberger & Zajicek, 2000).

As already mentioned by Hubert, Frank and Igo (2000) "it is hoped that implementation […] will produce better educated students so their agricultural and environmental issue decision-making will be enhanced" (p. 528).

Conclusions

The results show a consisting but still very low level of knowledge on grapevine and wine processing as representative examples of culturally important agricultural goods. Consequently, people, especially students and adolescents, need to be better educated. This research clearly reveals the need for new teaching approaches facing the participants' lack of knowledge on nature and agricultural goods. As you may only protect what you know, re-interaction with and understanding of the world around them is the only chance they get to understand biological correlations and develop a sustainable way of thinking. By experiencing regional ecosystems with school, students may be led back to nature. As agricultural ecosystems are widespread, found on every continent and have a direct connection to adolescents' environment and lives, these ecosystems may serve as excellent examples to convey knowledge on biology as well as food production processes. Consequently, getting into contact with their natural surroundings may help students grow up to responsible adults who do not only know more about nature than former generations. They may develop a feeling of appreciation for nature and handle sensible with food and food production to foster the idea of sustainable living and guarantee the existence of nature and biodiversity beside men.

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Appendix

Table A Items of the category vine's biology with the offered answer options or sample solutions and the number of reachable points, mean score and percentiles.

Sub-category	No.	Type of question	Item	Answer options. / Sample solutions.	Reachable points.	Mean value	Percentiles 25.	Percentiles Median	Percentiles 75.	Summary (sub-category)
Correct use of terminology	Q6	SC	A bunch of grapes is the inflorescence of vine.	True./False./Don't know.	1	0.65	0	1	1	Mean value: 2.33 *Percentiles:* 25.: 2 Median: 2 75.: 3
	Q7	SC	A grape is a bunch of grapes.	True./False./Don't know.	1	0.25	0	0	1	
	Q8	SC	A grape is a single fruit of an inflorescence.	True./False./Don't know.	1	0.48	0	0	1	
	Q9	SC	A bunch of grapes is a small, round fruit.	True./False./Don't know.	1	0.08	0	0	0	
	Q11	SC	Vine [Weinstock] may also be called vine [Rebe].	True./False./Don't know.	1	0.86	1	1	1	

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Sub-category	No.	Type of question	Item	Answer options. / Sample solutions.	Reachable points.	Mean value	Percentiles 25.	Median	75.	Summary (sub-category)
Charac-teris-tics of vine.	Q16	SC	Vine is a climbing plant.	True./False./Don't know.	1	0.82	1	1	1	
Interactions with the eco-system	Q13	SC	The vinegar fly (*Drosophila suzukii*) does not belong to vine's pests.	True./False./Don't know.	1	0.40	0	0	1	Mean value: 0.47 *Percentiles:* 25.: 0 Median: 0 75.: 1
	Q14	SC	The vinegar fly (*Drosophila suzukii*) lays its eggs on the grapes.	True./False./Don't know.	1	0.07	0	0	0	
Characteristics of vine as a plant	Q5	OE	How does vine absorb minerals?	Through its roots in the soil.	2	1.23	0	2	2	Mean value: 2.77 *Percentiles:* 25.: 2 Median: 3 75.:4
	Q23	MC	What is vine's main source of energy?	Nutrients from the soil. / Sunlight. / Carbon dioxide from the air. / Oxygen from the air. / I don't know.	2	0.90	0	1	2	
	Q24	MC	What is, from the perspective of vine, main product of photosynthesis?	Oxygen. / Sugar. / Carbon dioxide. / Minerals. / I don't know.	2	0.64	0	0	2	

Note: Type of questions: OE = Open-ended item, SC = Single-choice question, MC = multiple choice question. Questions and answers translated from German. In addition to the mean value median and other percentiles are given, as our data was not normally distributed. The items' names derive from their order within the question-naire, which was depending on the questions style.

Table B **Items of the category viticulture with the offered answer options or sample solutions and the number of reachable points, mean score and percentiles.**

Sub-category	No.	Type of question	Item	Answer options. / Sample solutions.	Reachable points.	Mean value	Percentiles 25.	Median	75.	Summary (sub-category)
General knowledge	Q1	OE	Which fruit is wine produced from?*	Grapes.	1	0.99	1	1	1	Mean value: 1.50 Percentiles: 25.: 1 Median: 2 75.: 1
	Q12	SC	The Romans brought vine to Germany.	True./False./Don't know.	1	0.51	0	1	1	

Sub-category	No.	Type of question	Item	Answer options. / Sample solutions.	Reachable points.	Mean value	Percentiles 25.	Percentiles Median	Percentiles 75.	Summary (sub-category)
Correct use of terminology	Q2	OE	What is the technical term for harvesting grapes?	Vintage. [Ger.: Lese]	2	0.95	0	0	2	Mean value: 4.44 Percentiles: 25.: 2 Median: 4 75.: 8
	Q18	MC	What is a vintner?	He is a farmer of vineyards. He is caring for the vines and responsible for the harvest./ He is a specially trained employee in a wine press house. He refines wines with special seasonings./ He is a wine steward. He advises guests in a restaurant about the wines./ He is an employee in a wine press house. He is responsible for the production of wine, sparkling wine and grape juice./ He is a chemist, who specialized on insecticides and fungicides./ I don't know.	2	0.88	1	1	1	
	Q19	MC	Vine/Wine is …	… an alcoholic drink. / … the leaf of a plant. / … a drink containing hop. / … a plant. / … a fruit of the vine plant. / … I don't know.	2	0.96	1	1	1	
	Q20	SC	What is mash?	That is the name of an organism, which is needed for wine production./ That is the puree, which results from crushing the grapes./ It is a juice, consisting of crushed grapes, which is meant for fermentation./ It is the term for the process of using hop for wine making/ I don't know.	2	0.79	0	0	2	
	Q21	SC	What is must?	That is the name of an organism, which is needed for wine production./ That is the puree, which results from crushing the grapes./ It is a juice, consisting of crushed grapes, which is meant for fermentation./ It is the term for the process of using hop for wine making./ I don't know.	2	0.86	0	0	2	
Process of wine making	Q3	OE	Why is vine planted on ter-races sometimes?	To avoid erosion.	2	0.89	0	0	2	Mean value: 3.41 Percentiles: 25.: 2 Median: 3 75.: 5
	Q10	SC	White wine is ex-clusively produced from the juice of white (=green) grapes.	True./False./Don't know.	1	0.25	0	0	1	
	Q15	SC	Yeast is necessary for the production of wine.	True./False./Don't know	1	0.30	0	0	1	
	Q22	MC	How does the alcohol get into wine?	By a chemical process named fermentation. / By malt which is added to the wine. / By the help of sugar and an organism which may convert this into alcohol. / By crushing the grapes with the feet. / By the brewing process. / I don't know.	2	0.94	1	1	1	
	Q25	SC	What is the best time for harvesting grapes?	July to August./ September to October./ April to June./ November to December./ I don't know.	2	1.32	0	2	2	

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Sub-category	No.	Type of question	Item	Answer options. / Sample solutions.	Reachable points.	Mean value	Percentiles 25.	Percentiles Median	Percentiles 75.	Summary (sub-category)
Food processing	Q4	OE	Name all things you can think of, which may be produced from vine.	Wine, Juice, Raisins.	2	1.01	1	1	1	Mean value: 1.37 Percentiles: 25.: Median: 75.:
	Q17	SC	The leaves of the vine plant are edible.	True./False./Don't know.	1	0.36	0	0	1	

*Note: Type of questions: OE = Open-ended item, SC = Single-choice question, MC = multiple choice question. Questions and answers translated from German. *Only open ended item for which only one point could be reached. In addition to the mean value median and other percentiles are given, as our data was not normally distributed. The items' names derive from their order within the questionnaire, which was depending on the questions style.*

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