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Environmental Values and Technology Preferences of First-Year University Students

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Abstract: Environmental and technological preferences correlate. Both are empirically accessible via established instruments such as the Two Major Environmental Value model (2-MEV) with "preservation" (PRE) and "utilization" (UTL), and the technology questionnaire with "interest in technology" (INT) and "social aspects of technology" (SOC). Additionally, "appreciation of nature" (APR) was monitored with a seven-item scale. We used these instruments to assess the preferences of freshmen in five different areas of study (law, economics, science, pedagogy, cultural studies). All subsequent analyses unveiled positive relations between appreciation and preservation, between the two technology subscales, as well as between utilization and social aspects of technology. Negative relationships appeared between preservation and utilization, preservation and both technology factors, as well as appreciation and social aspects of technology. In all subsamples, preservers (individuals with preservation preferences) showed little interest in technology or its social aspects; utilizers scored high in social aspects of technology, whereas appreciators displayed no interest in it. The freshmen's areas of study seem to predict consistent tendencies to (biocentric) preservation or (anthropocentric) utilization. Moreover, females were more likely to preserve and appreciate nature whereas males preferred utilization along with interest in technology as well as in the social implications of technology. The observed differences can be used to develop new and improve existing educational programs; recommendations are discussed.

Keywords: values; environmental attitudes; technology; gender; university freshmen

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1. Introduction

Currently, the "Fridays for Future" movement mobilizes young people around the globe. Pupils stay away from school on Fridays to show their commitment to the fundamental protection of our planet. Most often, only environmental aspects are considered in discussions about sustainability which prevents a consensus between our need to protect the environment and retain technological advances. Therefore, it is necessary to have a wider perspective on how to approach this delicate topic.

Social media and broadcasters, and their underlying technological advances, support the spread of this movement. Although technologies have a poor public reputation, politics and economics encourage a more technically oriented curriculum [1]. This entails the question of whether there is a connection between individual attitudes towards the environment and technology. In the past, instruments have been developed to measure environmental attitudes and preferences in technology, but these attitudes had to be measured independent of each other.

1.1. Measuring Environmental Attitudes

Since the 1970s psychometric efforts, valid and reliable measuring instruments have been developed to empirically assess young people's preferences of environment and technology. Despite being disputed, both the "new ecological paradigm" [2] and the Two Major Environmental Value model (2-MEV) [3–6] are widely used instruments; the latter was specifically developed for younger people. It contains two higher-order factors with one scale quantifying environmental perceptions: "preservation" (PRE) and "utilization" (UTL). The first highlights preferences reflecting conservation and protection of the environment; the latter measures the anthropocentric dimension of utilizing nature. In the following [7], the term "attitudes" is used for first order factors, and "values" for higher order factors. The 2-MEV was initially an instrument among many before independent research groups confirmed and integrated its framework: (i) Milfont and Duckitt [8] based their study on psychology freshmen, (ii) Johnson and Manoli [9,10] assessed earth education activities among 6th graders in the US, (iii) Boeve-de Pauw and Van Petegem [11] used a Flemish sample of secondary school students, (iv) Borchers et al. [12] applied it to a West African student sample, as did, very recently, Braun et al. [13] in Asia. As bi-national studies had also confirmed the battery's structure and validity (e.g., [4,14]), cross-validation studies were conducted, too: In a study cross-validated with the 2-MEV, the relationship between environmental values and risk tolerance proved that people with Preservation-preferences were cautious whereas "utilizers" were high risk tolerant [15]. Regarding the impact of personality, Wiseman and Bogner [5] reported a correlation of "preservation" (PRE) and "utilization" (UTL) with psychoticism, extraversion, and neuroticism [16]: utilizers aspire to self-gratification, whereas preservers prefer different gratifications. Moreover, Wiseman, Wilson, and Bogner, [17] showed PRE to be negatively and UTL to be positively correlated to authoritarianism, further contributing to an understanding of the framework's construction.

Although developed for adolescents, the 2-MEV scale is also applicable to adults such as pre-service and in-service teachers [18]. Both local and international studies used the 2-MEV to evaluate subjects in 16 European and North African countries [19]. Castéra et al. [20] confirmed the scale's suitability comparing teacher preferences of environmental values and Genetically Modified Organisms (GMO) in 30 countries.

The 2-MEV's two-factorial structure, although antithetical to each other, allows for measuring the appreciative use of nature without any destructive psychometric power [21]. The latter added a third dimension, "appreciation of nature" (APR), which extended the 2-MEV, measuring the enjoyable utilization of nature with seven items [21–23]. A previous exploratory factor analysis showed links between APR and PRE [22]. Following Campbell's paradigm [23], which describes connections between individual attitudes and subsequent behavior, a person who appreciates nature is more likely to protect it.

1.2. Measuring Preferences in Technology

Surprisingly, reliable measuring instruments exist for technology, although there is no standardized definition in literature: McRobbie et al. [24] asked teachers regarding their different conceptions of emotions concerning technology (which also is supposed to influence their teaching). Throughout their study, they described five different stances on the concept of technology: (1) The human and (2) social dimension of technology as well as technology described as (3) a process, (4) being situated in contexts, and (5) leading to products being developed. Monitoring "interest" (INT) and "social aspects of technology" (SOC) are relevant to preferences in technology. Initially, two subscales could be identified: "What is technology?" (Part A) is meant to measure "cognitive perceptions about the diversity of technology and technology as design process" [25] and "What do you think about technology?" (Part B) assessing "students' effect in terms of their interest in technology." Based on the Pupils´ Attitudes Towards Technology (PATT)-questionnaire [26], Rennie and Treagust [27] introduced the Attitudes and Perceptions About Technology (APAT)-questionnaire to evaluate technology education modules in primary and secondary schools. They [28] proposed seven subscales: career in technology, diversity of technology, importance of technology, interest, technology as a design process, and technology as problem solving, technology is easy. "Interest in technology" (APAT-questionnaire) and "social aspects of technology" (PATT-questionnaire) were, for instance, applied as subscales by Marth and Bogner [29] to evaluate students from different faculties and science teachers.

1.3. Is There a Relationship between Environmental Attitudes and Preferences in Technology?

The question, therefore, arises if attitudes towards technology and environment are related. In case of a relationship, corresponding recommendations to optimize, e.g., educational programs, could be provided to give the younger generation a comprehensive overview of both environmental protection and sustainability. A combination of both instruments is, thus, useful to examine environmental values and technology together. As technology increasingly dominates our daily lives, regardless of age or gender, it becomes more and more indispensable, significantly changing our lifestyles (eight distinct domains, e.g., learning, energy, and environment) [30]. Lifestyle refers to how we design our daily life, how we dress, or which attitudes we have [31]. Particularly young people use technology in an experience-oriented way, which may affect politics, education, social interaction, and technological advances. There are, however, hardly any research results on this yet [32]. Still, it must be considered that technology may also provide an opportunity to help limit our exploitation of natural resources by supporting efficient ways of sustaining them for future generations. The young, therefore, need the respective know-how to properly use the technologies at hand [28].

1.4. Does the Gender or Subject Sepzification Mater?

However, potential influences such as gender should also be considered as well as career decisions depend on individual attitudes. Since the 1990s, technology and related gender issues have been frequent targets of research [33,34] and are more relevant than ever [35]. In earlier studies regarding science, technology, engineering and mathematics (STEM) with different age groups, gender gaps in interest and social aspects in technology were considered very relevant [29]. Furthermore, science and related subjects (e.g., mathematics, biology, and physics) often appear difficult to understand and are less appealing to women. Thus, men often outnumber females by 2:1 regarding interest in STEM [36]. Possible explanations might be inconvenient experiences in the classroom which often determine preferences until adulthood [37] and maintain gender gaps [38,39]. In addition to gender influences, the question also arises if the choice of a subject specification is also influenced by such preferences. Therefore, it is reasonable to monitor freshmen from different subject areas regarding their attitudes towards technology and the environment.

1.5. Research Questions

In our present paper, we examine different aspects of individual environmental values and technology preferences as well as their mutual interaction. Our research objectives are three-fold: (i) To observe freshmen's preferences in technology in relation to environmental attitudes, (ii) to focus on subsamples of freshmen with different areas of subject (law, economics, science, cultural studies, pedagogy), as well as (iii) to search for potential gender differences in both scales.

2. Materials and Methods

For our study, we collected data from 264 (132 of them were females) freshmen (age $M = 22.06$ years) with five different areas of study: (1) law ($n = 49$), (2) economics ($n = 71$), (3) science ($n = 96$), (4) cultural studies ($n = 23$), and (5) pedagogy ($n = 25$). All participants visited the University of Bayreuth in the north of Bavaria, Germany. Questionnaires were distributed at the end of selected freshman lectures in the respective faculties to all present students at the beginning of the semester 2018. Students were informed about the voluntary and anonymous participation, the response rate was 100%, and the Ethics Committee of the University of Bayreuth approved the study.

All students completed a paper-pencil questionnaire, which included the 2-MEV along with the APR domain [22] as well as a short version of the technology questionnaire [29]. The response pattern followed a five-point Likert scale (1 = completely incorrect, 5 = completely correct) and was randomly mixed.

IBM SPSS Statistics version 24.0 (IBM, Armonk, NY, USA) was used for all statistical analyses. The item sets of both questionnaires were analyzed separately. For the 2-MEV, we conducted a principal component analysis (PCA) using an oblimin rotation. Since the sample size was large enough, we assumed a normal distribution based on the central limit theorem [40]. A univariate ANOVA followed by posthoc Bonferroni test was used to detect significant differences between the five student groups.

3. Results

In the following, we show (i) factor solutions for environmental values and technology preferences, (ii) correlations between both measuring instruments and their subscales, (iii) gender effects, and (iv) preferences of freshmen from different faculties.

The Kaiser–Meyer–Olkin measure confirmed sampling adequacy [41] with a value of 0.84. Kaiser and Rice [42] accepted values for the KMO measure exceeding 0.5 [40]. The Bartlett test displayed values of $p < 0.001$. Cronbach's alpha for the MEV scale was 0.73 and 0.83 for the short Technolgy Questionnaire (sTQ).

3.1. Factor Solution for Environmental Values

A factor solution was extracted reflecting preservation (PRE), "utilization" (UTL) and "appreciation" (APR), as delineated by Bogner [22] (Table 1). The factor structure of the MEV was confirmed, also resulting in the three main components, as described by Bogner [22]. Individual factor scores indicate how accurately a single variable measures the main components: higher values of the single factor score for each item correlated with stronger item values for the superordinate main components and vice versa. Two singular cross-loadings occurring for factors UTL and PRE indicate different degrees to measure both main components.

Table 1. Loading pattern of the Two Major Environmental Value model (2-MEV) with "preservation" (PRE), "utilization" (UTL) and additionally "appreciation of nature" (APR) (factor loadings under 0.3 are not shown).

Items	APR	UTL	PRE
I consciously watch or listen to birds.	0.767		
I enjoy gardening.	0.755		
I take time to consciously smell flowers.	0.749		
I deliberately take time to watch stars at night.	0.692		
I take time to watch the clouds pass by.	0.654		
I personally take care of plants.	0.649		
Listening to the sounds of nature makes me relax.	0.643		
We need to clear forests in order to grow crops.		0.684	
The quiet nature outdoors makes me anxious.		0.678	0.381
We must build more roads so people can travel to the countryside.		0.607	
We do not need to set aside areas to protect endangered species.		0.433	
Nature is always able to restore itself.		0.360	
Our planet has unlimited resources.			
Humans don't have the right to change nature as they see fit.			0.660
Humankind will die out if we don't live in tune with nature.			0.640
Not only plants and animals of economic importance need to be protected.			0.585
Human beings are not more important than other creatures.			0.542
Dirty industrial smoke from chimneys makes me angry.			0.505
People worry too much about pollution.		0.322	−0.504
I save water by taking a shower instead of a bath (in order to spare water).			0.359

3.2. Factor Solution of the Technology Preferences

A two-factor solution appeared for the total sample (Table 2), as reported by Marth and Bogner [29] and Rennie and Jarvis [25], regarding the technology questionnaire. High factor scores resulted in the confirmation of all variables measuring the main components "social aspects of technology" (SOC) and "interest in technology" (INT).

Table 2. Loading pattern of the technology questionnaire with "social aspects of technology" (SOC) and "interest in technology" (INT) (factor loadings under 0.3 were cut off).

Items	INT	SOC
I am interested in technology.	0.852	
I like to read books and magazines about technology.	0.748	
I would like to learn more about technology.	0.741	
I would like a career in technology later on.	0.718	
I would like to join a hobby club about technology.	0.627	
Technology has brought more good things than bad things.		0.870
Interventions in technology are doing more good than harm.		0.853
Technology makes the world a better place to live in.		0.675
It is worth spending money on technology.		0.603
Technology is needed by everybody.		0.582

3.3. Relationship of Both Measures

Figure 1 shows the Pearson correlation coefficients of environmental preferences with its subscales (PRE, UTL, APR (Table 3)) and of technology (INT, SOC meaning (Table 3)). We identified positive correlations between PRE and APR ($r = 0.422$, $p < 0.001$), INT and SOC ($r = 0.435$, $p < 0.001$) as well as UTL and SOC ($r = 0.186$, $p = 0.003$). Negative correlations were observed between UTL and PRE ($r = -0.345$, $p < 0.001$), INT and PRE ($r = -0.234$, $p \leq 0.001$), SOC and PRE ($r = -0.406$, $p < 0.001$) as well as SOC and APR ($r = -0.312$, $p < 0.001$). Monitoring the connection between APR and UTL showed no significant relationship ($r = -0.110$, $p = 0.083$).

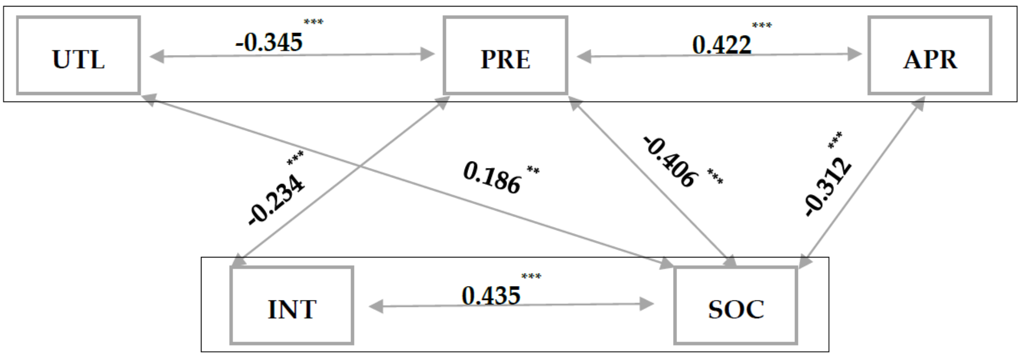

Figure 1. Pearson correlations between environmental values "preservation" PRE, "utilization" UTL and additionally "appreciation of nature" (APR) and technical preferences "social aspects of technology" (SOC) and "interest in technology" (INT). *p*-Values indicate significance-level (** $p \leq 0.01$, *** $p \leq 0.001$) (we displayed only significant correlations).

Table 3. Overview abbreviations of subscales for both instruments.

Abbreviation of the Subscale.	Meaning
PRE	Preservation of Nature
UTL	Utilization of Nature
APR	Appreciation of Nature
SOC	Social Aspects of Technology
INT	Interest in Technology

3.4. Gender Effects for the Different Subscales

We discovered significant differences between females and males in the total sample across all subscales. For the subscales PRE, APR and INT, the Levene-test was not significant so the values of the *t*-test were reported. For the subscales UTL and SOC, we used the Welch test.

The *t*-test produced significant differences between males and females in the subscales:

- PRE: females (N = 132, M = 3.96, SD = 0.60) and males (N = 130, M = 3.47, SD = 0.69) (95% CI (0.32, 0.63), t (260) = 5.96, $p < 0.001$)
- APR: females (N = 132, M = 3.17, SD = 0.91) and males (N = 130, M = 2.67, SD = 0.83) (95% CI (0.29, 0.71), t (260) = 4.67, $p < 0.001$)
- INT: females (N = 132, M = 2.07, SD = 0.66) and males (N = 131 M = 2.79, SD = 0.63) (95% CI (−0.88,–0.55), t (261) = −8.41, $p < 0.001$)

The Welch test yielded a significant difference between females and males in the subscales UTL (females (N = 132, M = 1.69, SD = 0.42) and males (N = 130, M = 1.89, SD = 0.59) (95% CI (−0.32, −0.07), t (232.63) = −3.16, p = 0.002)) as well as SOC (females (N = 131, M = 3.16, SD = 0.50) and males (N = 131, M = 3.74, SD = 0.71 (95% CI (−0.74, −0.44), t (232.87) = −7.74, $p < 0.001$; see Figure 2).

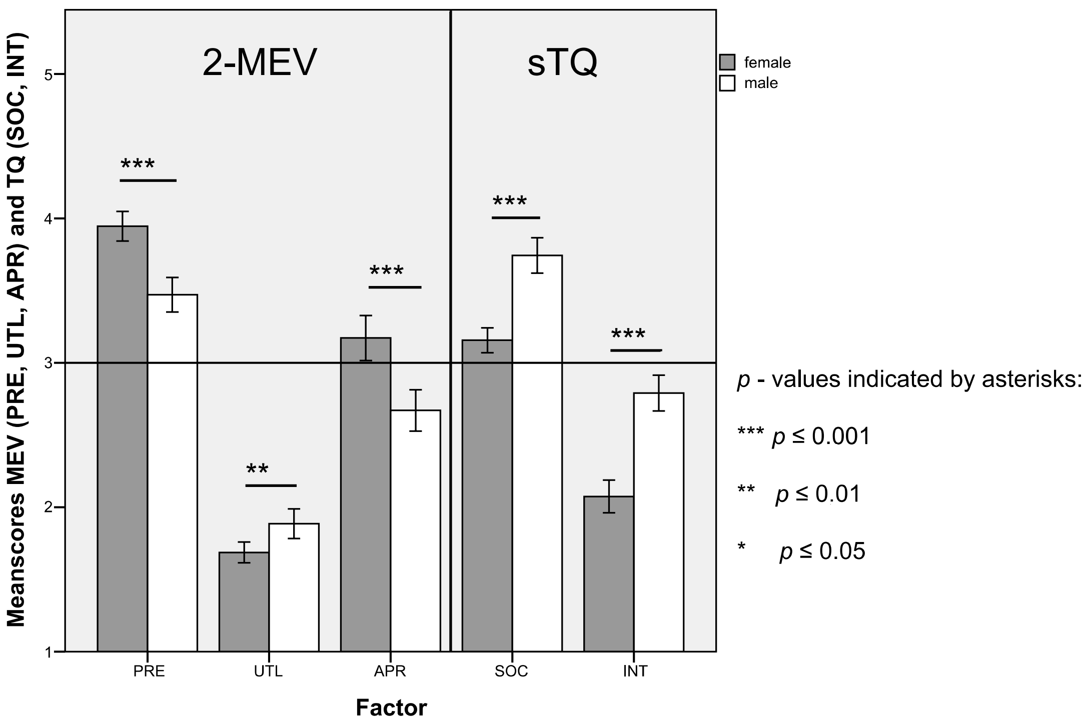

Figure 2. Scores of environmental values PRE, UTL of the Two Major Environmental Value model (2-MEV) and APR as well as of the short Technology Questionnaire (sTQ) with "social aspects of technology" (SOC) and "interest in technology" (INT) split by gender. Bars are 95% confidence intervals. *p*-Value indicates significance-level.

3.5. Different Attitudes of Freshmen of Various Faculties

Comparing freshmen´s attitudes from all five faculties, the subscales PRE, APR, and SOC produced differences between the observed groups, whereas UTL and INT did not. Mean scores of each group in each subscale were used for all calculations. The ANOVA showed a significant effect F (4, 250) = 6.47, $p < 0.001$ for the five observed groups in PRE. Bonferroni post-hoc test for PRE reported significant differences between "law" (M = 3.46. SD = 0.84) and "science" (M = 3.92, SD = 0.62; $p \leq 0.001$) as well as between "economics" (M = 3.50, SD = 0.64) and "science" (M = 3.92, SD = 0.62; $p \leq 0.001$; Figure 3). The ANOVA test also yielded significant differences for APR across the five different groups: F (4,

249) = 8.36, $p < 0.001$). The Bonferroni posthoc test for APR yielded significant differences between "law"—($M = 2.75$, $SD = 1.00$) and "science"students ($M = 3.26$, $SD = 0.80$; $p \leq 0.010$) as well as between "economics"—($M = 2.63$, $SD = 0.80$) and "science" students ($p < 0.001$). Moreover, there are significant distinctions between "economics" and "cultural studies" students ($M = 3.25$, $SD = 0.95$; $p = 0.003$). Also "pedagogy" students ($M = 2.51$, $SD = 0.80$) scored differently in APR within the "cultural studies" ($M = 3.25$, $SD = 0.95$; $p = 0.034$) and the "science" sample ($M = 3.26$, $SD = 0.80$; $p = 0.001$); see Figure 4.

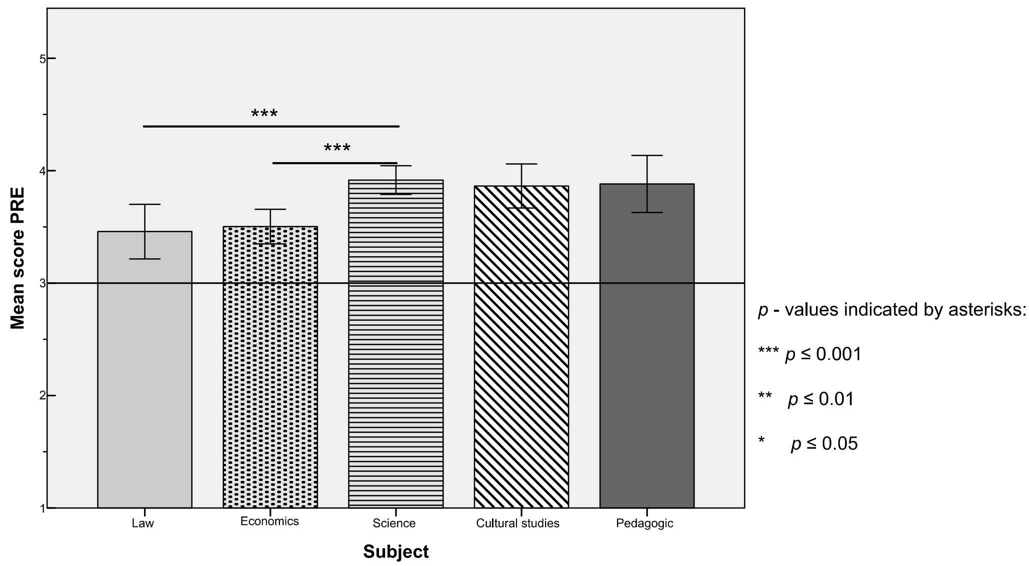

Figure 3. Mean scores of the sub-scale "preservation" (PRE) and the five different areas of study. Bars are 95% confidence intervals. *p*-Value indicates significance-level.

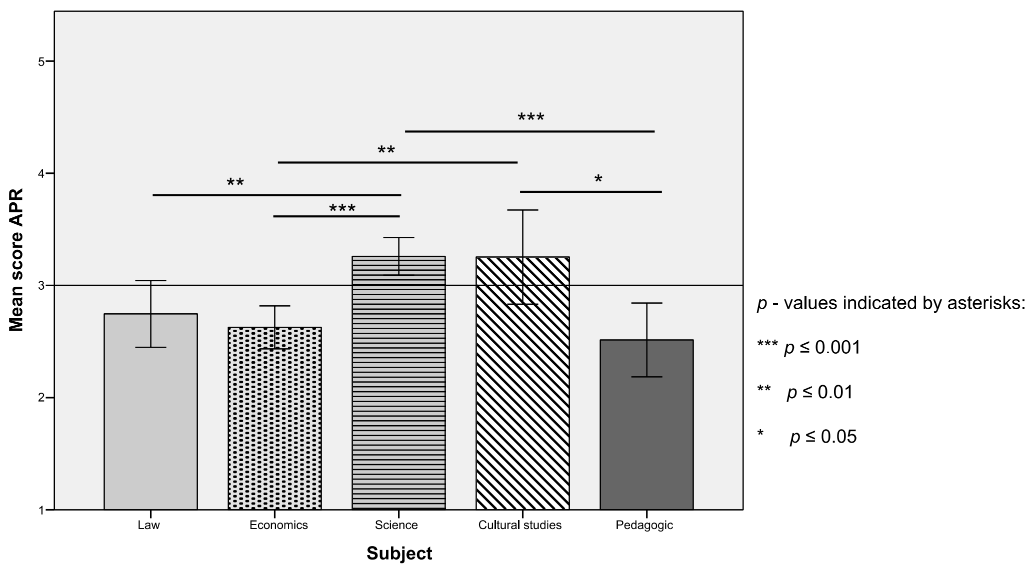

Figure 4. Mean scores of the sub-scale "appreciation" (APR) and the five different areas of study. Bars are 95% confidence intervals. *p*-Value indicates significance-level.

UTL did not produce an effect between the five observed student groups, nor did INT. For SOC, the ANOVA yielded significant effects between the five observed groups F (4254) = 6.23, $p <$ 0.001. After applying Bonferroni posthoc test for SOC, significant differences between "law"($M = 3.66$, $SD = 0.63$) and "cultural studies"students remained ($M = 2.96$, $SD = 0.61$; $p < 0.001$) as well as between "economics"($M = 3.63$, $SD = 0.67$ and "cultural studies"studies ($p < 0.001$; Figure 5).

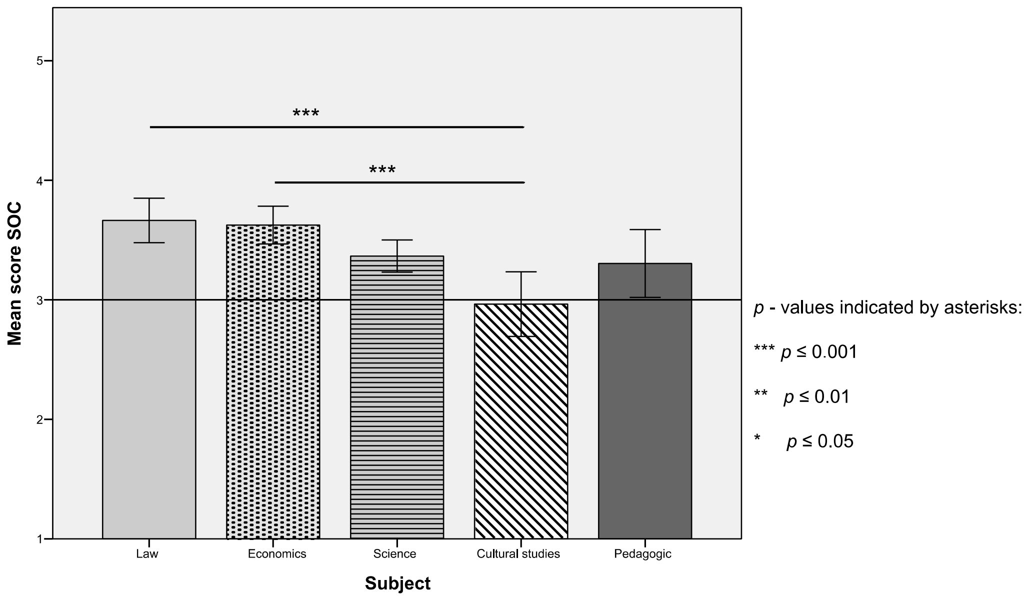

Figure 5. Mean scores of the sub-scale "social" (SOC) and the five different areas of study. Bars are 95% confidence intervals. *p*-Value indicates significance-level.

4. Discussion

Individual environmental values and technology preferences of freshmen matter and interact. (i) The observation of freshmen's preferences in technology related to environmental attitudes showed positive correlations between UTL (utilization of nature) and SOC (social aspects of technology) as well as negative correlations between PRE/APR (preservation/appreciation of nature) and the technical preferences INT and SOC (Figure 1). (ii) Monitoring gender differences in both subscales displayed significant differences in each subscale (Figure 2). (iii) Looking at the different subject areas, significant differences in PRE between science and economics as well as law (Figure 3) could be observed. Furthermore, we recorded significant differences for SOC between cultural studies and economics as well as law (Figure 5) and significant differences for APR between several subject areas (Figure 4).

4.1. Environmental Attitudes of Freshmen

As previous studies [9,19,22] have already indicated, the bi-dimensional structure of the 2-MEV scale even occurred when the applied items set was shortened, and the APR scale was added. Especially in on-site outreach assessments, short versions are easier to apply.

A study examining college students' use of social media reported that all sampled students use social networks [43]. In social media, our planet's limited resources are very topical. Lower factor loadings of the item "Nature is always able to restore itself" and "People worry too much about pollution" (see Table 1) stress the need for change. Thus, students have discussions about environmental challenges with their peers, family, and friends via social media and are informed about the topic. Still, there might be a need for more profound educational programs to get a clear, holistic overview of the different topics comprising environmental disciplines, interfaces with humanities, and technological disciplines.

In addition, cross-loadings of UTL_5 ("People worry too much about pollution.") reveal that students who tend to use nature as a resource are not willing to protect it. As explained by Kibbe et al. [44], this is due to the contrasting two factors. Only the item "The quiet nature makes me anxious" askes for participants' emotions, especially their worries. Utilizers prefer to exploit nature, e.g., in technological processes or industry. Thus, silence in nature is experienced as the opposite of industrial growth and progress, which preservers would enjoy as they see nature as a place of recreation and recovery. It should nonetheless be remarked that admiring nature could also be part of utilization, although this kind of utilization would not count as exploitation (preying on nature or damaging it) [22], because it does not harm nature visibly. Therefore, it is necessary to show people cycles of matter in nature. Thus, people understand that not only obvious environmental pollution can cause damage to nature, but also that processes in nature are disturbed, for instance by human mass tourism.

4.2. Use of Technology in Modern Society Influences Interest in Technology

We obtained a two-factor solution: Factor loadings for "interest in technology" and "social aspects of technology" are high and reliably measure the interest in technology and the social relevance of technology (see Table 2). We, thus, showed that students who are interested in technology also accept technology in society. This is not surprising as today the use of technologies is omnipresent. Lepp, Barkley and Karpinski [45], for instance, observed the distribution and use of smartphones on college campuses where they are frequent devices to obtain information, to learn, or to communicate via social media. Sometimes, they are even used as a life logging device [46]. The item "Technology is needed by everybody" has the lowest factor loading and is in line with findings of Marth and Bogner [29], where university freshmen yielded an even lower score. A possible explanation would be that students already know technologies, e.g., smartphones, are non-essential for life. Factor loadings for social aspects of technology are high, proving the scale's reliability and applicability to different age groups. Based on these results, it is possible to develop and implement educational programs specifically designed for this target group.

4.3. Correlation between Environmental Attitudes and Technology Preferences

As seen in Figure 1, PRE and UTL correlate negatively, as reported Bogner and Wiseman [47] or Kibbe et al. [44]. Bogner et al. [48], on the basis of large longitudinal cohort data, confirmed the structure. In contrast to utilizers, preservers do not exploit nature, which is consistent with the 2- MEV scale's initial meaning. APR and UTL do not correlate, giving no information on how utilizers appreciate nature but revealing their interest in exploiting nature. Furthermore, there is a positive correlation between APR and PRE (see Figure 1) which is in line with earlier studies [49,50]: Appreciators tend to preserve nature and act eco-friendly. INT and SOC correlate positively showing that students who are interested in technology also accept technological progress in society.

Besides confirming the findings of earlier studies, we combined both structures (2-MEV and technology questionnaire) and recorded negative correlations between PRE and INT/SOC which imply that preservers have little or no interest in technology. A possible explanation could be the low social acceptance and the almost unstoppable progress of technology. Thus, appreciators who are fond of nature do not accept technology in society. We also found a positive relationship between UTL and SOC, showing that people who are willing to exploit nature also accept technology in society. To develop educational initiatives that aim at educating students about sustainability, it is important to keep in mind that some aspects of technology oppose nature conservation. Therefore, such programs should use as many different channels of information as possible in order to address as many groups as possible. A less polarized overview of both technology and nature and their mutual interaction can help to avoid misconceptions.

4.4. Gender Differences Regarding Environmental Attitudes and Technology Preferences

We recorded stereotypical gender differences for all subscales in both questionnaires. In an analysis covering the various fields of environment and technology, it was possible to show that women and men have different perceptions of technology and the environment.

Women are more likely to act environmentally friendly, scoring higher in PRE and APR (see Figure 2) which is in line with earlier studies (e.g., [4]) This phenomenon prevails across all social groups and cannot be explained with ethnicity or religion [51]. One approach to explaining different environmental behaviour is based on gender roles and socialization [52,53]. Following socialization theory, behaviour is rooted in early childhood socialization processes. According to Beutel & Mooney [51], Eagly [54], or Zelezny et al. [53], women across different cultures have more pronounced "ethics for care": they seem to be more compassionate, more cooperative, and more helpful in nursing roles. Values [7] are, therefore, able to predict behavior to a certain extent [53,55]. Women also display more altruistic and helping behavior particularly when they take responsibility for a person or recognize potential hazards. This is also in line with the findings of Beutel and Mooney [51], who described women as ready to take responsibilities and aware of other people's physical comfort.

In contrast to females, males score higher in UTL, INT and SOC. Thus, men are more willing to exploit nature, to profit from it, or to show materialistic and anthropocentric behavior. Beutel and Mooney [51] take competitiveness and quest for social status as a basis to explain this behavior. Not only environmentally friendly behavior follows social stereotypes but also attitudes towards technology [56].

Today women are also established in male domains such as STEM subjects but are still underrepresented. We discovered significant differences between males and females for SOC and INT: men are more interested in technology and open to the social implications of technologies than women. Marth and Bogner [29] also reported this phenomenon for pupils, students, and teachers, although differences for the subscale SOC were smaller and there were no significant differences in the teachers´ group [25,57]. The question is when exactly the gender gap develops in a child's socialization process. Dasgupta and Stout [38] suggest three possible developmental stages for establishing gender differences: from childhood to adolescence, in nascent adulthood, and middle-aged adulthood. It is well known that children learn social stereotypes from parents' behavior [58]. Another factor influencing young adults is their social peer group [59]. Whatever the reasons, women in STEM careers are under-represented and sometimes, despite strong affiliation to the subject, avoid such careers [38]. Therefore, it would also interesting to look at the phenomenon's distribution across different programs to see how this global trend develops in young adults attending university.

4.5. Personal Preferences Strongly Influence Technology and Environmental Attitude Sets

A study by Munoz et al. [19] observing a pre- and in-service teacher cohort of 16 countries showed the 2-MEV structure as a very robust and reliable instrument for different social and economic contexts in different countries. In our study, we assessed five different groups of freshmen regarding their environmental attitude and looked for correlations with different areas of study. Especially science and cultural studies showed significantly higher scores compared to law and economics concerning preferences like "enjoying the garden" or "taking time to smell flowers". The same trend is visible for PRE. Utilization showed no significant differences between the observed study groups. Looking at all subscales, economics and pedagogy, however, slightly differ. With regard to environmental attitudes, the largest and most significant differences appear in the science sector between PRE and APR.

Especially, natural scientists are committed to protecting nature, as is reflected in the group comparisons using PRE and APR. This leads to the conclusion that people who tend to protect or appreciate nature are more likely to study science. People who are interested in economics are consequently less interested in the beauty and the protection of nature. The origin of these preferences may be back in childhood; this needs further research. This relationship seems even more important as many political decisions are based on economic rather than scientific considerations. Current political initiatives, however, may have the power to reverse this dependency.

Looking at SOC, economic groups (law and economics) differ from humanities groups (cultural studies and education). We observed the same pattern for the APR subscale, proving that people who show little interest in APR tend to be more technically interested. This claim is also supported by negative correlations between APR and SOC. As modern technologies, e.g., smartphones, enable students to be more independent, it is apparent that technological developments are not only disadvantageous for the environment. Technical progress can support environmental protection and is necessary to show students the beauty of nature all around the globe without traveling. Thus, promoting positive attitudes towards environmental protection should be possible through technologies at university and in the classroom. The findings of McRobbie et al. [24] suggest that various educational initiatives in schools or universities may improve students' understanding of technologies. Taught in a relaxed learning atmosphere, units about the scientific aspects of technology, e.g., limitation of fossil fuels, climate change or advantages and disadvantages of potential technical solutions. in consequence, students should feel comfortable with technologies at the beginning of their lessons to be successful in this field later on. It requires positive attitudes towards technology regardless of the chosen course of study [29].

4.6. Limitations of the Study

Our study only represents a small group proportion of the population (freshmen). To get a holistic idea of the interrelationships, several studies with several groups of people will have to be conducted. Especially studies in elementary or middle schools would help to understand preference developments or the gradual appearance of gender differences. Within this context, our study of freshmen preferences shows results of primary and secondary education before specialisation in the tertiary sector. This is important to brainstorm a suitable educational intervention. Data about the impact of different study areas later on would also shed light on preference developments.

In the questionnaire, no socio-biographical data were collected since universities have an international audience. For further research, however, it would be reasonable to collect this data to analyse their influence on the respective attitudes.

5. Conclusions

Our study shows that it should be a future goal of higher education to link environment and technology in the educational programs to meet the zeitgeist. At the beginning of university, students from different subject areas have different attitude-sets, although they have just entered their study programs and have not yet obtained any degree. Thus, differences will probably increase after having finished their degrees. Only holistically educated students are in a position to solve problems with regard to sustainability and technological progress. Therefore, further research will be required to understand when and why preferences for the environment or technology are formed. A collaboration between technological research groups and natural scientists or other sciences is to recommend to add as much information as possible to find an ideal solution. Our study shows a strong connection between individual preferences and attitudes of students towards technology and the environment. This is relevant to create educational programs designed for each target group.

Our sample of young adolescents contains either technology-enthusiastic "utilizers" or technology-critic "preservers". As preferences seem to be already set in freshmen's minds, more profound education about environmental issues maybe needs its introduction earlier at school levels. Developing holistic educational approaches (such as including aspects of technology, environment and sustainability) might be a key to overcome the well-known gaps, especially as today's young adolescents are the politicians, scientists, and decision-makers of tomorrow. Combining questions regarding environmental attitudes and technology may offer opportunities to optimize educational programs. Investigating primary and secondary school students' attitude-sets towards technology and environment might help to evolve school programs minimizing the gap between environment and technologies.

The gender gap is another crucial unsecured open side, as students' individual preferences influence their later specialization: specific technical courses for girls might convince them not to follow stereotypes. Thus, schools should make more effort, for instance, by integrating technical courses into regular curricula and thus to reduce stereotypical gender socialization in childhood.

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References

1. Ardies, J.; De Maeyer, S.; Gijbels, D. Reconstructing the Pupils Attitude Towards Technology-survey. *Des. Technol. Educ. Int. J.* **2013**, *18*, 8–19.
2. Dunlap, R.E.; Van Liere, K.D.; Mertig, A.G.; Jones, R.E. New Trends in Measuring Environmental Attitudes: Measuring Endorsement of the New Ecological Paradigm: A Revised NEP Scale. *J. Soc. Issues* **2000**, *56*, 425–442. [CrossRef]
3. Bogner, F.X.; Wiseman, M. Toward Measuring Adolescent Environmental Perception. *Eur. Psychol.* **1999**, *4*. [CrossRef]
4. Bogner, F.X.; Wiseman, M. Environmental perspectives of Danish and Bavarian pupils: Towards a methodological framework. *Scand. J. Educ. Res.* **1997**, *41*, 33–71. [CrossRef]
5. Wiseman, M.; Bogner, F.X. A higher-order model of ecological values and its relationship to personality. *Pers. Individ. Differ.* **2003**. [CrossRef]
6. Bogner, F.X.; Wiseman, M. Adolescents' attitudes towards nature and environment: Quantifying the 2-MEV model. *Environmentalist* **2006**, *26*, 247–254. [CrossRef]
7. Rokeach, M. *Beliefs, Attitudes, and Values: A theory of Organization and Change*, 1st ed.; Jossey-Bass: San Francisco, CA, USA, 1968.
8. Milfont, T.L.; Duckitt, J. The structure of environmental attitudes: A first- and second-order confirmatory factor analysis. *J. Environ. Psychol.* **2004**, *24*, 289–303. [CrossRef]
9. Johnson, B.; Manoli, C.C. Using Bogner and Wiseman's Model of Ecological Values to measure the impact of an earth education programme on children's environmental perceptions. *Environ. Educ. Res.* **2008**, *14*, 115–127. [CrossRef]
10. Johnson, B.; Manoli, C. The 2MEV Scale in the United States: A Measure of Children's Environmental Attitudes Based on the Theory of Ecological Attitude. *J. Environ. Educ.* **2010**, *42*, 84–97. [CrossRef]
11. Boeve-de Pauw, J.; Van Petegem, P. The Effect of Flemish Eco-Schools on Student Environmental Knowledge, Attitudes, and Affect. *Int. J. Sci. Educ.* **2011**, *33*, 1513–1538. [CrossRef]
12. Borchers, C.; Boesch, C.; Riedel, J.; Guilahoux, H.; Ouattara, D.; Randler, C. Environmental Education in Côte d'Ivoire/West Africa: Extra-Curricular Primary School Teaching Shows Positive Impact on Environmental Knowledge and Attitudes. *Int. J. Sci. Educ. Part B Commun. Public Engagem.* **2014**, *4*, 240–259. [CrossRef]
13. Braun, T.; Cottrell, R.; Dierkes, P. Fostering changes in attitude, knowledge and behavior: Demographic variation in environmental education effects. *Environ. Educ. Res.* **2017**, *24*, 899–920. [CrossRef]
14. Bogner, F.X.; Wiseman, M. Environmental perception of French and some Western European secondary school students. *Eur. J. Psychol. Educ.* **2002**, *17*, 3–18. [CrossRef]
15. Bogner, F.X.; Brengelmann, J.C.; Wiseman, M. Risk-taking and environmental perception. *Environmentalist* **2000**, *20*, 49–62. [CrossRef]
16. Eysenck, H.; Eysenck, S. *Personality Structure and Measurement (Psychology Revivals)*; Routlege: London, UK, 1969. [CrossRef]
17. Wiseman, M.; Wilson, G.; Bogner, F.X. Environmental Values and Authoritarianism. *Psychol. Res.* **2012**, *2*, 2159–5542.
18. Oerke, B.; Bogner, F. Gender, age and subject matter: Impact on teachers' ecological values. *Environmentalist* **2009**, *30*, 111–122. [CrossRef]
19. Munoz, F.; Bogner, F.; Clement, P.; Carvalho, G.S. Teachers' conceptions of nature and environment in 16 countries. *J. Environ. Psychol.* **2009**, *29*, 407–413. [CrossRef]

20. Castéra, J.; Clément, P.; Munoz, F.; Bogner, F.X. How teachers' attitudes on GMO relate to their environmental values. *J. Environ. Psychol.* **2018**, *57*, 1–9. [CrossRef]
21. Kaiser, F.G.; Brügger, A.; Hartig, T.; Bogner, F.X.; Gutscher, H. Appreciation of nature and appreciation of environmental protection: How stable are these attitudes and which comes first? *Eur. Rev. Appl. Psychol.* **2011**, *64*, 269–274. [CrossRef]
22. Bogner, F.X. Environmental values (2-MEV) and appreciation of nature. *Sustainability* **2018**, *10*, 350. [CrossRef]
23. Kaiser, F.G.; Hartig, T.; Brügger, A.; Duvier, C. Environmental Protection and Nature as Distinct Attitudinal Objects: An Application of the Campbell Paradigm. *Environ. Behav.* **2013**, *45*, 369–398. [CrossRef]
24. McRobbie, C.J.; Ginns, I.S.; Stein, S.J. Preservice Primary Teachers' Thinking About Technology and Technology Education. *Int. J. Technol. Des. Educ.* **2000**, *10*, 81–101. [CrossRef]
25. Rennie, L.J.; Jarvis, T. Three approaches to measuring children's perceptions about technology. *Int. J. Sci. Educ.* **1995**, *17*, 755–774. [CrossRef]
26. de Klerk Wolters, F. A PATT Study Among 10 to 12-Year-Old Students in the Netherlands. *J. Technol. Educ.* **1989**, *1*. [CrossRef]
27. Rennie, L.J.; Treagust, D.F. Measuring students' attitudes and perceptions about technology: A multidimensional concept. *Res. Sci. Educ.* **1989**, *19*, 221–230. [CrossRef]
28. Rennie, L.; Treagust, D.; Kinnear, A. An Evaluation of Curriculum Materials for Teaching Technology as a Design Process. *Res. Sci. Technol. Educ.* **1992**, *10*, 203–217. [CrossRef]
29. Marth, M.; Bogner, F.X. Monitoring a gender gap in interest and social aspects of technology in different age groups. *Int. J. Technol. Des. Educ.* **2019**, *29*, 217–229. [CrossRef]
30. Hanafizadeh, P.; Ghandchi, S.; Asgarimehr, M. Impact of Information Technology on Lifestyle. *Int. J. Virtual Communities Soc. Netw.* **2017**, *9*, 1–23. [CrossRef]
31. Ye, Q.; Li, G.; Gu, B. A cross-cultural validation of the web usage-related lifestyle scale: An empirical investigation in china. *Electron. Commer. Res. Appl.* **2011**, *10*, 304–312. [CrossRef]
32. Tully, C.J. Growing up in technological worlds: How modern technologies shape the everyday lives of young people. *Bull. Sci. Technol. Soc.* **2003**, *23*, 444–456. [CrossRef]
33. Acker, S.; Oatley, K. Gender Issues in Education for Science and Technology: Current Situation and Prospects for. *Can. J. Educ.* **1993**, *18*, 255–272. [CrossRef]
34. Kay, R. Exploring Gender Differences in Computer-Related Behaviour. *Soc. Inf. Technol.* **2018**, 12–30. [CrossRef]
35. Mayer-Smith, J.; Pedretti, E.; Woodrow, J. Closing of the gender gap in technology enriched science education. *Comp. Educ.* **2000**, *35*, 51–63. [CrossRef]
36. Sadler, P.M.; Sonnert, G.; Hazari, Z.; Tai, R. Stability and volatility of STEM career interest in high school: A gender study. *Sci. Educ.* **2012**, *96*, 411–427. [CrossRef]
37. Simpson, R.D.; Steve Oliver, J. A summary of major influences on attitude toward and achievement in science among adolescent students. *Sci. Educ.* **1990**, *74*, 1–18. [CrossRef]
38. Dasgupta, N.; Stout, J.G. Girls and Women in Science, Technology, Engineering, and Mathematics: STEMing the Tide and Broadening Participation in STEM Careers. *Policy Insights Behav. Brain Sci.* **2014**, *1*, 21–29. [CrossRef]
39. Hill, C.; Corbett, C.; St Rose, A. *Why So Few? Woman in Science and Technology, Engineering anf Mathematics*; AAUW: Washington, DC, USA, 2010.
40. Field, A.; Miles, J.; Field, Z. *Discovering Statistics Using SPSS*, 4th ed.; Carmichael, M., Ed.; Sage Publications: Thousand Oaks, CA, USA, 2013. [CrossRef]
41. Kaiser, H.F. A Second-generation Little Jiffy. *Psychometrika* **1970**, *35*, 401–415. [CrossRef]
42. Kaiser, H.F.; Rice, J. Little Jiffy, Mark Iv. *Educ. Psychol. Meas.* **1974**. [CrossRef]
43. Sponcil, M.; Gitimu, P. Use of social media by college students: Relationship to communication and self-concept. *J. Technol. Res.* **2012**, *4*, 1–13.
44. Kibbe, A.; Bogner, F.X.; Kaiser, F.G. Exploitative vs. appreciative use of nature—Two interpretations of utilization and their relevance for environmental education. *Stud. Educ. Eval.* **2014**, *41*, 106–112. [CrossRef]
45. Lepp, A.; Barkley, J.E.; Karpinski, A.C. The Relationship Between Cell Phone Use and Academic Performance in a Sample of U.S. College Students. *SAGE Open* **2015**, *5*, 2158244015573169. [CrossRef]
46. Rawassizadeh, R.; Tomitsch, M.; Wac, K.; Tjoa, A.M. UbiqLog: A generic mobile phone-based life-log framework. *Pers. Ubiquitous Comput.* **2013**, *17*, 621–637. [CrossRef]

47. Bogner, F.X.; Wiseman, M. Environmental Perception: Factor Profiles of Extreme Groups. *Eur. Psychol.* **2002**, *7*, 225–237. [CrossRef]
48. Bogner, F.X.; Johnson, B.; Buxner, S.; Felix, L. The 2-MEV model: Constancy of adolescent environmental values within an 8-year time frame. *Int. J. Sci. Educ.* **2015**, *37*, 1938–1952. [CrossRef]
49. Raab, P.; Randler, C.; Bogner, F. How Young "Early Birds" Prefer Preservation, Appreciation and Utilization of Nature. *Sustainability* **2018**, *10*, 4000. [CrossRef]
50. Roczen, N.; Kaiser, F.G.; Bogner, F.X.; Wilson, M. A Competence Model for Environmental Education. *Environ. Behav.* **2014**, *46*, 972–992. [CrossRef]
51. Beutel, A.M.; Mooney, M. Gender and Values. *Am. Sociol. Rev.* **1995**, *60*, 436–448. [CrossRef]
52. Wilkinson, S.; Kitzinger, C. *Representing the Other: A Feminism & Psychology Reader*; Sage Publications: Thousand Oaks, CA, USA, 1996.
53. Zelezny, L.; Chua, P.; Aldrich, C. Elaborating on Gender Differences in Environmentalism. *J. Soc. Issues* **2000**, *56*, 443–457. [CrossRef]
54. Eagly, A.H. *Sex Differences in Social Behavior: A Social-Role Interpretation*; Distinguished Lecture Series; Lawrence Erlbaum Associates: Hillsdale, NJ, USA, 1987.
55. Olson, J.M.; Zanna, M.P. Attitudes and attitude change. *Annu. Rev. Psychol.* **1993**, *44*, 117–154. [CrossRef]
56. Johnson, J.P. Can Computers Close the Educational Equity Gap? *Perspect. Civ. Rights Q.* **1982**, *14*, 20–25.
57. Brown, C. Bridging the gender gap in science and technology: How long will it take? *Int. J. Technol. Des. Educ.* **1993**, *3*, 65–73. [CrossRef]
58. Eccles, J.; Jacobs, J.E.; Harold, R. Gender Role Stereotypes, Expectancy Effects, and Parents' Socialization of Gender Differences. *J. Soc. Issues* **1990**, *46*, 183–201. [CrossRef]
59. Eaton, M.Y.; Mitchell, L.M.; Jolley, M.J. Gender differences in the development of relationships during late adolescence. *Adolescence* **1991**, *26*, 565–568. [PubMed]