GERMAN STUDENTS' PERCEPTION OF BIOECONOMY – AN EXPLORATORY STUDY

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Abstract
In the present society, the concept of bioeconomy emerged due to the need for a sustainable and responsible change regarding the impact mitigation of several factors on the environment. The rising consumption and the resulting emission of pollutants are interconnected with both economic and population growth. Therefore, measures must be taken using new technologies and solutions, improvement of production methods and the necessary transformation of society through education. Several universities have aligned with the demands and needs of the present and future society regarding sustainability, called 'transformative universities'. A high-quality education system is a prerequisite to sustainable and transformational efforts as well as transparent, participative processes and a close dialogue and cooperation between science, economy, politics and civil society.
The purpose of this research is to bring more awareness, receptivity and responsiveness to the problems of society with a focus on bioeconomy.
Therefore, this article is divided into three sections. The first part comprises a summary of bioeconomy related to education and the role of higher education institutions in societal transformation processes. The second part contains the quantitative and qualitative analysis and evaluation of the results of an explorative online survey about the perception of bioeconomy and sustainability of students exemplified by students from two German universities. The third part concludes the article with a summary of findings and prospects for further researches in this area.
This research is useful especially for public and educational institutions, organisations that have a direct or indirect impact on the environment, and other stakeholders interested in environmental conservation.

Keywords: bioeconomy, sustainability, higher education institutions, third mission, transformative university, societal transformation processes

JEL Classification: Q56, Q57, I23, D83, O1

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Introduction

The future is changing, and with technological developments, demographic changes, and the impact on the planet and its resources of recent decades, these changes are becoming more rapid and their effects more perceptible. A few decades ago people mainly related the technological and scientific progress with economic growth, the enhancement of the quality of life and wealth. However, the growing awareness on the current economic development, population growth, humanity's impact on the environment, the ever-increasing consumption and emission of pollutants do not support sustainability and will result in global economic and social crisis and depletion of non-renewable resources. This is also amplified by the ever-increasing impacts of climate change worldwide. In this context, terms such as sustainability, circular economy, and bioeconomy arose as possible concepts for solving essential challenges of the 21st century. The urgency of pursuing solutions for these challenges are pushed by governments, institutions, politics, science, and economy. For a sustainable and responsible change of the way society and the economy interact with the environment, a science-based understanding of causes and effects, the development of new solutions, business models and technologies, collaboration and knowledge sharing across divisions and borders are necessary. It can be stated that sustainable development is complex, multidimensional, and requires a transdisciplinary approach which involves different fields like technology, economy, ecology, sociology, politics, science and education (Blewitt and Cullingford, 2013).

In this article, the authors target the higher education sector. To be able to reach the 2030 Bioeconomy strategy of the European Union it is essential to enforce education within this topic. Current students will be the managers of the future, therefore must be valued as an important target group for bioeconomic issues. Until now only little empirical research has been conducted to research the current state of students' perception of bioeconomy. Therefore, in this paper an exploratory approach aims to get first insights of the status quo of the perception of bioeconomy amongst students of two selected German universities to lay a foundation for future studies in this increasingly important issue.

1. Review of the scientific literature

1.1. Developments in the European Bioeconomy and its current focal points

In recent years the concept of bioeconomy has become more important in politics as well as in research, economy, and education. The bioeconomy got a boost in 2012 due to the European Commission strategy "Innovating for Sustainable Growth: A Bioeconomy for Europe". In 2014 the EU launched the hitherto biggest EU research and innovation programme 'Horizon 2020', with a funding of nearly 80 billion Euros over seven years (2014-2020), which places a strong focus on innovation facing societal transformation processes (BMBF, 2014). Within this strategy, the European Commission defined that "The bioeconomy encompasses the production of renewable biological resources and the conversion of these resources and waste streams into value-added products, such as food, feed, bio-based products, and bioenergy." (EC, 2012, p.2). Due to the newest scientific and economic knowledge and the changed political context (e.g. Sustainable Development Goals (SDGs), Paris Climate Agreement and some other EU political initiatives), the European Commission has launched a review and update of the Bioeconomy Strategy and Action Plan (EC, 2018a). Likewise, the report from the German Bioeconomy Council

(GBC, 2018a) shows that over 50 countries worldwide have developed and launched bioeconomy strategies. In figure no. 1 the different strategies were clustered by focus area and per continent.

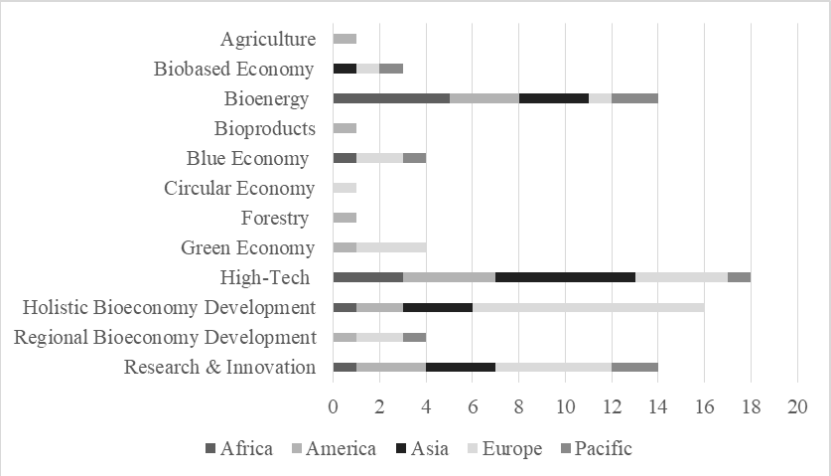

Figure no. 1: Cluster bioeconomy strategies per focus area

Source: Authors own compilation based on the report from the GBC, 2018a

The identified common core of these strategies is the reinforcement of innovation and development, the use of new technologies and solutions, the improvement of production methods and the necessary transformation of society regarding usage and consumption. Research, knowledge, education, and social participation are essential prerequisites for a holistic bioeconomic development and a sustainable bioeconomy. Therefore, recent research increasingly focuses on the interactions between all actors involved (Lewandowski, 2018, Merrill et al., 2018). For example, the Fraunhofer Institute for System and Innovation ISI carried out a workshop in January 2017 within the framework of the research project "BioKompass" dealing with communication and participation in the societal transformation towards bioeconomy. One of the most significant findings to come from this workshop is that the discourse on the role of the society in a bioeconomy is still at its very beginning. The discourse, therefore, should extend beyond just creating acceptance for new technologies towards the question of whether a technological change may also lead to a paradigm change in society. Thus, the effects of a bioeconomy on social participation, values, or equity should be discussed more thoroughly within society (Fraunhofer ISI, 2018). In this context, it is vital to understand the different perceptions of the concept of bioeconomy amongst societal groups. An Austrian study showed that the concept is perceived in different ways depending on the societal group belonging, though a general lack of knowledge about bioeconomy exists (Stern et al., 2018).

The University of Suceava in Romania deducted an exploratory study with students to understand how knowledge transfer influences student knowledge about bioeconomy. They found out that there is a moderate degree of interest to participate in bioeconomy scientific research. They indicate that this might be a result of lack of familiarity and knowledge

regarding the topic. They could not find a difference in knowledge between technical and social-science student profiles (Bejinaru et al., 2018). A survey in Poland investigated the knowledge and attitudes of students regarding bioeconomy at the Warsaw University of Life Sciences being part of the Euroleague of Life Sciences. The author showed that most of the investigated student sample had not heard about the concept and had not heard it in their university. However, after providing the students with a definition of the concept, 70% showed interest in the topic and 63% even interest participating in an elective course. Another key result of the survey was that there are paradoxical views amongst students regarding the field of study of bioeconomy and therefore their interest in the subject was narrow. While students in the economic field considered, that bioeconomy related to agriculture and food-science, life science students had the opposing view majorly relating it to economic topics (Drejerska, 2018).

Discussions on education and the role of higher education and social change were an integral part in this year's "Global Bioeconomy Summit" and the "European Bioeconomy Congress", which also saw the launch of a European bioeconomy education platform (EBCL, 2018; GBC, 2018b). In the Bioeconomy Stakeholders Manifesto (EC, 2017) and the 9th Bioeconomy Stakeholders Panel (EC, 2018b) the enhancement of education and vocational training, cross-over curricula and life-long learning programmes were pointed out as important aspects. The need for relevant and system-approach knowledge was identified to enable bioeconomy business and the societal transition, and the demand for close cooperation and best practice sharing.

1.2. The role of higher education institutions in societal transformation processes

Due to the challenges of the knowledge society like lifelong learning or digitalisation, as well as sustainability issues as e.g. interconnectedness, societal challenges and relationships steadily gain in importance. The inclusion of all supplemental tasks and activities exceeding teaching and research at an HEI are subsumed under the term 'third mission' (Cervantes, 2017). Third mission thus focuses on the linking, exchange and reciprocal interaction of universities and the civil society by supporting and developing social or regional commitment, social innovations or cooperation with civil society partners and companies (Roessler et al., 2015). In scientific literature, this integration of universities, industry, and the government is discussed under the concepts 'Triple Helix', established by Etzkowitz and Leydesdorff (2000), and 'Quadruple Helix', if the public and civil society are additionally joined (Unger and Polt, 2017). To become sustainable, Schneidewind and Singer-Brodowski (2014) call for a science which actively promotes transformation processes. Universities which are consequently and systematically incorporating current challenges into their teaching and research are thus called 'Transformative Universities'. As there are controversies in scientific discourse about the universities' precise role and impact on a sustainable society, Bien et al. (2017) argue that every university must reflect its' individual position within the societal transformation process.

A high-quality education system is a prerequisite to sustainable and transformational efforts as well as transparent, participative processes and a close dialogue and cooperation between science, economy, politics and civil society. Excellence and sustainable success will be increasingly determined by the responsible use of the competencies available in a company or society (Herget, 2018). These competencies do not mean abstract knowhow, but specific

skills and capabilities directly attached to the people. An important task thus is the teaching of transformation knowledge, which refers to a person's common knowledge of transformational processes (Schneidewind and Singer-Brodowski, 2015). One possible implementation in this respect is 'service learning', signifying both a learning approach by incorporating social commitment in higher education courses, and the social involvement of a university itself. Thereby, the HEIs support the students to develop their personality, to reflect their position about societal action, to question assumptions, (pre-) judgments and attitudes, and to shape up a separate, differentiated view (Altenschmidt and Miller, 2016). In special relation to sustainability, Sterling (2010-11) suggests transformative or epistemic learning that changes people's perception of and interaction with the world. Perception is "the way in which something is regarded, understood, or interpreted" (Oxford dictionary, 2018). To enable this so-called 'third order learning' critical reflection is necessary, which fosters a "paradigm shift and the emergence of new ways for society." (Palma and Pedrozo, 2016, p. 16).

2. Research methodology

This article is structured in three main parts. On the basis of systematic literature research, there is a summary of bioeconomy related to education and the role of HEIs in societal transformation processes in the first part. The second part contains the quantitative and qualitative analysis and evaluation of the results of an exploratory online survey. With this survey's data, the authors aimed to answer the following open research questions: What is the current state of perception of sustainability and bioeconomy among academic students? Can the students differentiate between those two concepts? Are there differences between groups concerning age, gender or other implications? To gain this first insight this study explicitly dispensed with a previously given definition, to capture the students' uninfluenced perception, that – according to the definition provided above, includes the comprehension as well as the interpretation of a topic.

After performing a pre-test amongst doctoral colleagues and incorporating minor modifications, the survey was conducted between 2nd of February and 5th of March 2018 at one Romanian public University, and two German Universities of Applied Sciences selected based on personal contacts of the authors. Both German universities offer similar disciplines and degrees but represent different locations (in the east and west of Germany) and study models. The target group thus were students, either full- or part-time. The web-based survey software QuestionPro was used to create this online questionnaire. In Germany the student bodies were contacted via email, one university additionally distributed the survey via the Facebook page of the sustainability's rector's office; in Romania, all students of a master course were contacted via email request. The survey was accessible in German and English, participation was voluntary and anonymously. The questionnaire had in total seven questions concerning the topic (three selecting and matching questions and four multiple-choice rating questions with a 3 level Likert-style rating), a demographical part and the possibility to insert a free text. The average time to complete the survey was 13.6 minutes, which goes in line with the average completion time of 15 minutes suggested in the literature (Brace, 2018).

In total 439 participants answered the survey, and after cleaning the data sets, 403 valid questionnaires were evaluated and statistical processed. There was a major non-response

bias based on refusal on the survey sample regarding the Romanian side as from 65 surveyed students only 20% responded and 18% were valid. Therefore, the bias would have been over 82 points off. The authors attribute the bias to the survey period which fell into the universities examination period which might have been the reason for students to focus on exams and not on the survey. Therefore, the authors decided to use only the valid questionnaires from the German students for the analysis and result presentation. The sample can be clustered as follows (table no. 1).

Table no. 1: Description of the dataset used

GE Universities answered	**426**		**GE University valid (92%)**	**392**
Residence			**Study Model**	
Germany	94.90%		Part-time students	75.77%
Other countries	5.10%		Full-time students	24.23%
Gender			**Age Range**	
Female	25.00%		<30	47.96%
Male	72.70%		30-39	35.97%
Don´t want to tell	2.30%		>39	16.07%

Source: Authors' calculations based on 426 answered questionnaires from the students of the German Universities

Additionally, the part-time students reported the industry they are working in, and the full-time students both their semester and study field (merged to either STEM-subjects – namely sciences, technology, engineering, mathematics – and others). The authors decided upon an explorative approach to get an initial impression. By probationary significance tests, a-priori-hypotheses can be derived for further statistical testing. According to the variables and either the testing of correlation or differences in means the standard statistical tests were used based on best practices in empirical research. The third part concludes the article with the summary of the findings and prospects for further research in this area.

3. Results

3.1. Students' distinction between the terms Sustainability and Bioeconomy

Nowadays many terms are used without having a clear understanding of their meaning and their context. Hence, the authors assumed, that most of the people only subjectively and individually interpret the terms Sustainability and Bioeconomy. As a result, they cannot provide precise definitions or explicitly distinguish between both concepts. Therefore, without the provision of a preconceived definition to both terms, students were asked to match eight given characteristics of bioeconomy and sustainability to each term based on their understanding. Three of the eight aspects were matched wrongly by more than half of the students; only the last two aspects were correctly assigned by the majority (figure no. 2). Overall only 5.5% of the students have given the correct matching for all eight aspects, which confirms that both concepts could not be distinguished.

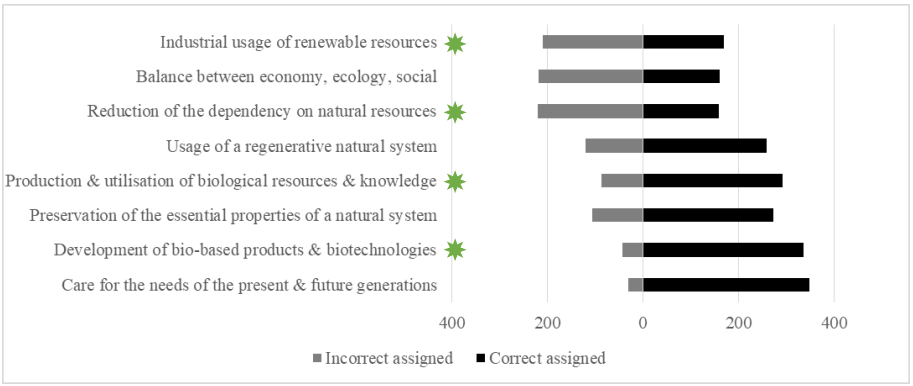

Figure no. 2: Aspects and their assignment to Bioeconomy and Sustainability

Source: Authors' calculations based on dataset of 383 (98 female and 285 male) answers

*Note: * - Directly influenced by bioeconomy*

The answers to the question: 'Which of the 17 SDGs of the "Agenda 2030" can be positively influenced with the help of the bioeconomy over the next 12 years' give a similar impression (figure no. 3). Three goals "Life Below Water", "Life On Land" and "Zero Hunger", which are mainly addressed by bioeconomy, were ranked very low.

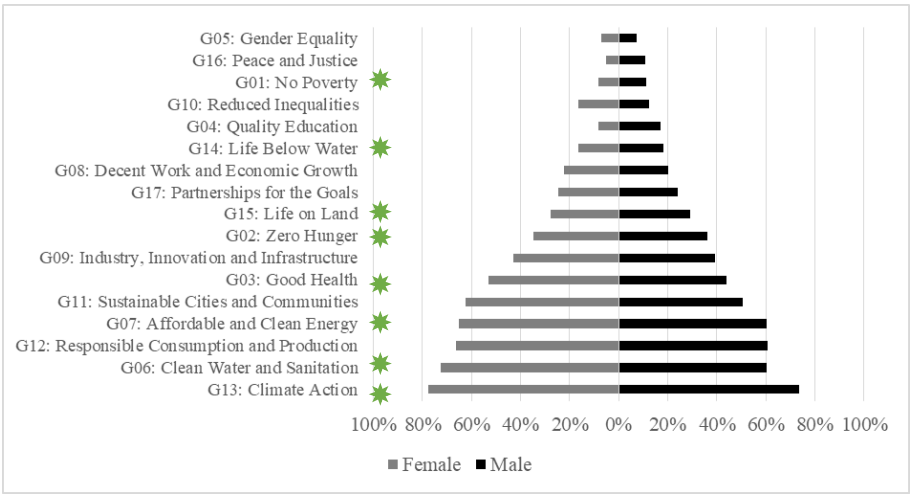

Figure no. 3: 17 SDGs positively influenced by bioeconomy over the next 12 years

Source: Authors' calculations based on dataset of 383 (98 female and 285 male) answers

*Note: * - Directly influenced by bioeconomy*

To further explore the students' perception of these topics, the authors statistically analysed the data with SPSS®. Both descriptive and inferential statistics were used. The demographical data consist of categorical variables comprising two as well as more than

two groups. The variables showing the students' correct mapping abilities were built by counting the number of perfect matches per student within the specific question. The higher the number of correct matches, the higher the understanding is assumed. The statistical techniques were appropriate to the data, therefore Pearson or Spearman tests analysed if there are significant correlations between different demographical aspects (like age or gender) and both the ability to correctly assign the concepts and to understand the influence of bioeconomy on the SDGs exist. Significant differences between the groups were analysed with either t-test, Mann-Whitney-U-test, ANOVA or Kruskal-Wallis-test. The results revealed no significant relationships between the students' ability to correctly assign the concepts of bioeconomy and sustainability (right_map_biosust) and any of the demographic variables. The same applies to the understanding of the bioeconomy's influence on the SDGs (right_map_sdg) – with the following exceptions.

There was a negative relationship between the age and the ability to understand the influence of bioeconomy on the SDGs, which proved to be significant at the .01 level (2-tailed), r = - .153, p = .004. A one-way ANOVA was conducted to assess the effects of the students' age. Age was divided into three categories: <30 years (M = 3.68, SD = .126), 30-39 years (M = 3.15, SD = .132) and >39 years (M = 3.05, SD = 0.413). There was one mild outlier, according to inspection with a box-plot in category 30-39. Data were normally distributed for each group (Q-Q plots), and there was homogeneity of variance (Levene's test, $p > .05$). The correct relation of bioeconomy to the SDGs differed statistically significant for the different ages, F (2, 346) = 4.550, p = .001, η^2 = .026, which is a small effect according to Cohen (1998). Hochberg's GT2 post-hoc analysis revealed a significant difference ($p < .05$) between the age groups < 30 and 30-39 (.527, 95 % - CI [.08, .97]). Thus, the ability to assign bioeconomy's influence on the SDGs generally and significantly declines with age. This could either be a general phenomenon or due to specialization in specific research areas during higher degree studies, as Beijnaru et al. (2018) proved a significant difference by education cycles showing that doctoral students showed less interest in the topic as bachelor undergraduates. In this respect, further research should be conducted, for example regarding generation differences or personal development life cycles, resulting in an approach how to better inform and involve the different generations in the social transformation process.

The variable studymode (representing the study model) was not normally distributed for each group (Q-Q plots), so a Mann-Whitney-U-test was conducted. The correct allocation of SDGs effected by bioeconomy by full-time students (Mdn = 4) differed significantly from the part-time students' ability (Mdn = 3), U = 16689.000, z = 2.732, p = .006, r = .138 (small effect). It follows that full-time students have a significantly higher ability to match bioeconomy to the SDGs correctly than part-time students. The latter could be due to the fact, that the researched population represents two different study models. The full-time students' HEI offers study courses and lectures about bioeconomy and sustainability, the part-time students' HEI does not. The influence of different study models and lectures provided should be further researched on the basis of a sample covering a higher amount of universities.

Apart from the beforementioned differences, the detailed investigation showed that neither men nor women, younger nor experienced students, full- nor part-time-, nor STEM-students have a fundamental higher ability to deal with the concepts of bioeconomy and sustainability. The results show that a general understanding exists regarding both concepts,

but still, there is potential for improvement and the deepening of knowledge about bioeconomy and sustainability for all investigated students.

3.2. Students' perception of Sustainability and Bioeconomy

In the survey, the authors also targeted the students' opinion concerning bioeconomy. The results show a gap in perception. On the one hand, the impact of bioeconomy on educational institutes and the HEIs' influence on politics and economy are estimated relatively low (figure no. 4 and 5).

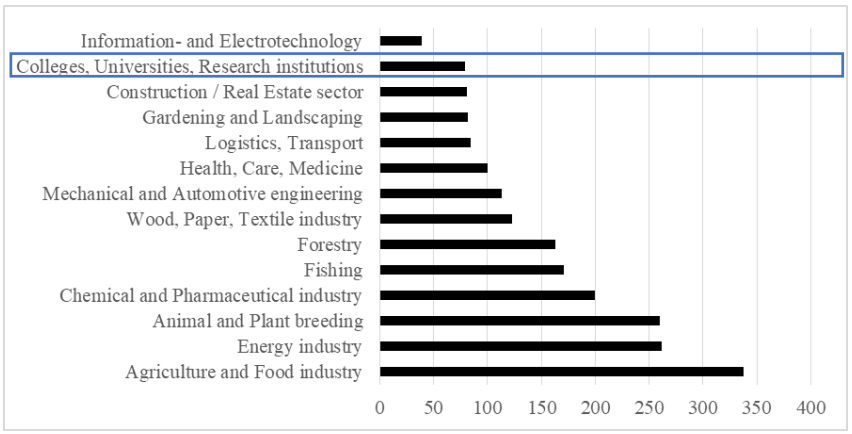

Figure no. 4: Sectors mostly changing due to the influence of the bioeconomy
Source: Authors' calculations based on dataset of 392 complete answers

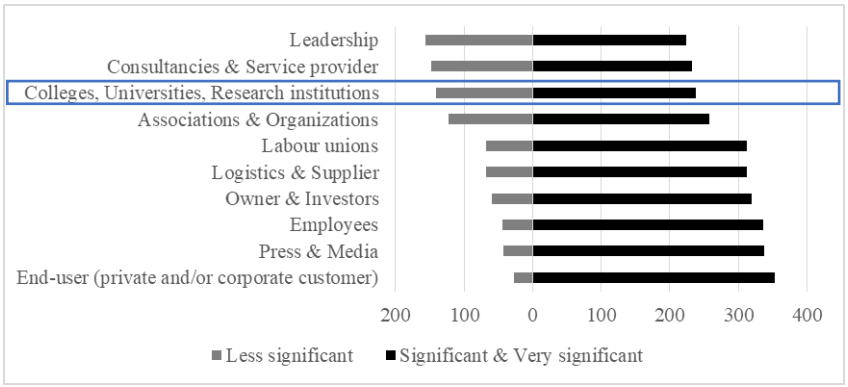

Figure no. 5: Stakeholders' importance to influence politics and the economy regarding bioeconomy and sustainability
Source: Authors' calculations based on dataset of 380 complete answers

On the other hand, the question about the urgency of the need for action regarding the promotion and implementation of bioeconomy and sustainability measures in their home country showed a relatively high rating. To statistically analyse this discrepancy, first, a variable expressing an overall need for improvement was built (need_action_biosust) by

summing up the perception of the importance of all improvement areas per student. The higher the total (range 0-30), the more "need for change" is assumed. Again, after first statistically processing the data regarding the demographical aspects, no significant correlations could be found. Same applies to differences in means between the respective groups. The different assessments of the students shown in the charts above have been additionally processed in three variables: influ_HEI (expressing the degree of bioeconomy's influence on HEIs), imp_HEI (the students' perception of the importance of a HEI as a stakeholder in future bioeconomical changes) and needaction_HEI (the perceived urgency of the improvement of HEIs and implementation of Bioeconomy and Sustainability measures in HEIs). All these variables are categorised by 1=no indication or less significant, 2=significant and 3=very significant.

The analysis of correlations and differences in means resulted in the following findings. All variables have a significant positive correlation ($p < .001$) to the "need for change"-variable. Exemplary the following boxplot shows that the mean level of perception of needaction_HEI increases from "no indication and less significant" to "significant" and to "very significant" as the "need for change" variable increases (figure no. 6).

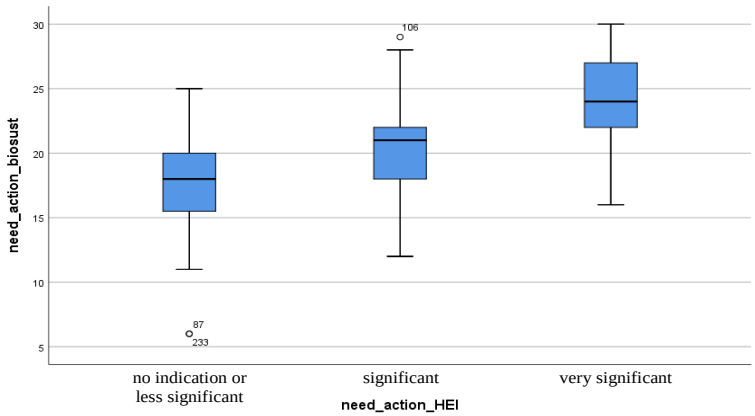

Figure no. 6: Boxplot of perception of the need for improvement in all areas by the degree of urgency of improvement of HEIs

Source: Authors' calculations based on dataset of 392 valid answers

One-way ANOVAs were conducted, data was normally distributed for each group in each variable (Q-Q plots), and there was homogeneity of variance (Levene's test, $p > .05$). This applies to all three variables. Table no. 2 comprises the test statistics.

Table no. 2: Test statistics of "Need for Change"

Variable	needaction_HEI	imp_HEI	influ_HEI
Categories	*M* = 17.24	*M* = 20.14	*M* = 20.39
1	*SD* = 3.605	*SD* = 4.580	*SD* = 4.722
2	*M* = 20.37	*M* = 20.26	*M* = 20.70
	SD = 3.260	*SD* = 4.196	*SD* = 4.032
3	*M* = 24.36	*M* = 22.44	*M* = 22.76
	SD = 3.414	*SD* = 4.020	*SD* = 3.879

Variable	needaction_HEI	imp_HEI	influ_HEI
Correlation (2-tailed)	r = .603*	r = .232*	r = .238*
Univariate ANOVA	$F(2, 389) = 112.313$ $p < .001$, $\eta^2 = .366$**	$F(2, 389) = 12.587$ $p < .001$, $\eta^2 = .061$**	$F(2, 389) = 13.721$ $p < .001$, $\eta^2 = .066$**
Post-hoc-tests (Hochberg's GT2)	Significant difference ($p < .001$) between all groups: 1 and 2 (-3.134, 95%-CI [-4.39, -1.88]) 1 and 3 (-7,123, 95%-CI [-8.38, -5.86]) 2 and 3 (-3.990, 95%-CI [-4.87,-3.11])	Significant difference ($p < .05$) between the groups: 1 and 3 (-.124, 95%-CI [-2.40, 2.16]) Significant difference ($p < .001$) between the groups 2 and 3 (-2.137, 95%-CI [-3.22, -1.05])	Significant difference ($p < .001$) between the groups: 1 and 3 (-2.364, 95% - CI [-3.74, -.99]) 2 and 3 (-2.060, 95% - CI [-3.17, -.95])

Source: Authors' calculations based on the dataset (N = 392)
Notes: * The correlations are significant $p < .001$ (2-tailed).
** According to the classification by Cohen (1988), the effective power of $\eta^2 = .366$ shows a high effect, $\eta^2 = .061$ and $\eta^2 = .066$ both show medium effects.

The higher the need for change towards bioeconomy and sustainability is assumed in a student's home country the higher the urgency of improving the HEIs actions in future bioeconomical changes, the higher the importance of HEIs as a stakeholder and the higher the urgency of the improvement of HEIs in that respect is perceived. These results suggest the importance of the HEIs role in bioeconomical or sustainability issues. Based on this finding further studies should be initiated to identify in more detail the requirements students have towards HEIs about the bioeconomical change, e.g. what type and format of lectures should be offered or how HEIs could improve the position as an influencing stakeholder.

Conclusions

This study showed that a person's age and a student's chosen study model, which in this case also reflects the educational programme offered by HEIs, have an impact on the assessment of bioeconomy and sustainability. Moreover, the German students surveyed have no outstanding knowledge concerning bioeconomy and sustainability that exceeds the average. Except for the age, in the case of matching bioeconomy and the 17 SDGs, there are no demographic differences either. The perception of the need for action concerning the implementation of bioeconomy in all areas of public life is only slightly above average, too. However, the higher the need for such action is assessed, the higher the importance of HEIs in this context is valued.

Nevertheless, this study is subject to some limitations. The students of only two universities were analysed. As the aim of this study was to obtain initial findings on possible differences within different groups of the population of students, non-random ad hoc samples by self-selection samples suffice. In market and opinion research, therefore, the criterion "fit for purpose" is proposed as an appropriate criterion instead of a global

representation of samples (Döring and Bortz, 2016). There are distortions regarding population conditions, yet, this study's probationary significance tests explicitly only deliver speculative ex-post explanations, which can serve as a basis for the formulation of a-priori-hypotheses for further studies.

Some points concerning the conception of the questionnaire could be optimised. Part-time students could not insert data relating to their study, as vice versa full-time students could work beneath their studies. The survey did not capture this information. Age and semester were only clustered in categories. The scales could have been refined, as the questions relating to the HEIs just offered the possibility to choose three categories (less significant, significant and very significant). Students with a negative assessment could only choose less significant or could not answer at all. Same applies to students who probably did not answer because they do not have a notion. Though differing between bioeconomy and sustainability in the "knowledge"-part, the questions regarding the perception covered both concepts together.

Based on the outcome subsequent in-depth research is recommended to explore further the interaction of influencing factors on a person's comprehension of these specific topics, or to bring on a broader context, for example to the different generations and their general perceptions or the external influences on humans by business and social environment. HEIs can benefit from this research by being enabled to conclude the improvement of their offered study programme, to lead the way towards a paradigm shift in the critical field of bioeconomy and towards societal transformation. If education and especially HEIs as providers of scientific higher education focus on an education based on the needs for having a sustainable bioeconomy they could take a leading role and increase their influence on politics and economics. Likewise, the high ranking for "Society" in the question about the need for action regarding the promotion and implementation of bioeconomy and sustainability measures in their home country reflects the growing awareness and power seen in everyone to drive the change towards sustainable food, energy and water systems based on innovative concepts and contemporary values. If HEIs miss this opportunity, other players on the market will substantially shape the development, probably intensifying undesirable developments, like the concerns some students addressed in the free texts of the survey.

In these free texts, many respondents painted a cynical and pessimistic view of today's society, be it politics, economy or the nature of humanity. The maximisation of profits, greed, egoism and an 'après moi, le déluge'-attitude are mentioned as the only motives driving the development of innovative approaches, methodologies or products. This is assumed to result in an intentional disregard of the need of solving problems like overpopulation, underdeveloped infrastructure, distortive effects of investment aid for large companies resulting in a decline of R&D, and to foster only selective approaches without covering the entire value chain, consumer behaviour, especially concerning meat consumption and waste, or biased media coverage. Bioeconomy is expressed to be a short-term manipulation of ecology without knowing the effects, and a contrary to biodiversity, therefore in contradiction to sustainability. These concerns and pessimistic positions only present individual opinions but show the need for a transparent and knowledge-based discourse; a discourse that can only base on education. A change in education takes time, requires a lot of feedback and experiences as well as financial and human resources but is essential for the future, as stated by Einstein: "We cannot solve our problems with the same thinking we used when we created them" (Mielach, 2012).

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