Volume 21 Issue 18
Originally issued as H5

Global Journal of Science Frontier Research: H
Environment & Earth Science
Volume 21 Issue 5 Version 1.0 Year 2021
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Toward Better Tasks in Sustainability Education: Search for New Approaches on Online Platforms

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GJSFR-H Classification: *FOR Code: 139999*



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I. Introduction

Sustainability education has become an important topic in the educational sciences since the 2009 Bonn Declaration at the latest. On the subject of sustainability education, individual studies have been carried out, which deal with the representation of this topic in primary schools (cf. Andersen, 2018; Hus, 2013; Jones et al., 2012; Lloyd & Gray, 2014). The question regarding the representation of contents to sustainable development in textbooks has been pursued by the TAPSE study using the example of Luxembourgish primary school (see Andersen, 2018). Following on from the demands of the 2009 Bonn Declaration (UNESCO, 2009), the 2012 Report on the UN Decade of Education for Sustainable Development (UNESCO, 2012) and the Global Education Monitoring Report (UNESCO, 2016), the TAPSE study could show that there is still considerable unrealized potential with regards implementing environmental issues in Luxembourgish primary science textbooks and the need to anchor content on sustainability education more explicitly (Andersen, 2018). After new tasks in primary science education have recently been developed in online formats (e.g., bbb, 2020; DIPF, 2021; HKM, 2020; Maué, Schönheit & Trauth, 2019), the question arises, to what extent the new tasks stimulate the engagement with content on sustainable development. Considering that in 2015 the 2030 Agenda for Sustainable Development (UN, 2015) set new targets for the next 15 years, today, after the first third of the period, it is necessary to ask which of these targets have been anchored in the newly developed primary science tasks. The O-TAPSE study (Online Tasks in Primary Science Education) addresses this question in a multi-stage process.

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II. Theoretical Framework: Theories of Sustainable Development

Understanding theories of sustainable development is the key to reflecting on the concept behind the 2030 Agenda for Sustainable Development. Enders and Remig (2016) claim that sustainable development cannot only been viewed as "the establishment of a permanent, globally practicable and future-capable mode of life and economics, but as a complex array of problems involving a wide range of social-scientific and humanistic disciplines". Taking such a wide view of sustainable development as a starting point, the O-TAPSE study follows on from a theoretical approach that overlaps the established academic boundaries. It views the concept of development according to Todaro and Smith (2006) as a multi-faceted process, implying reduction of inequality, economic growth, eradication of absolute poverty as well as changes in social structures, attitudes, and institutions. With reference to the concept of sustainability according to Stoddart (2011), the O-TAPSE study is based on a definition that encompasses the equitable and efficient distribution of resources within and between generations and within the limits of a finite ecosystem. Based on a systematic literature analysis, Mensah (2019) comes to the conclusion that sustainable development is a core concept of the global development policy and agenda. According to Mensah (2019) and based on the findings of Browning and Rigolon (2019), sustainable development can be defined as a development paradigm and a concept that calls for improving living standards without endangering the earth's ecosystems or causing environmental problems such as deforestation or water and air pollution that can lead to problems such as species extinction or climate change.

In the 2030 universal Agenda for Sustainable Development (UN, 2015), 17 Sustainable Development Goals (SDGs) and 169 targets were anchored, which aim at stimulating action over the next 15 years in areas of critical importance for humanity and the planet. This includes the five areas (a) people, (b) planet, (c) prosperity, (d) peace, and (e) partnership (UN, 2015, p. 2). The area, which is entitled *people*, aims to end poverty and hunger, ensuring that all people are able to fulfil their potential with equal rights and in a healthy environment. The second area focuses on protecting the

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planet from degradation, including sustainable consumption and production, sustainable management of its natural resources, and urgent action against climate change to meet the needs of present and future generations. The area *prosperity* aims to enable all people to lead a fulfilling life and to achieve economic, social and technological progress in harmony with nature. *Peace* is the fourth area of the SDGs and involves promoting peaceful and inclusive societies free from fear and violence. The final area, *partnership*, aims to mobilize the resources needed to implement the above mentioned objectives in the context of a global partnership for sustainable development, based on a spirit of increased global solidarity, focusing in particular on the needs of the poorest and most vulnerable and involving all countries, stakeholders and people (see for detail UN, 2015).

The O-TAPSE criteria catalogue (Fig. 1) follows on from the above mentioned five fields of action with the corresponding 17 SDGs, which are defined by the UN (2015) as follows: (a) no poverty; (b) no hunger; (c) good health and well-being; (d) quality education; (e) gender equality; (f) clean water and sanitation; (g) affordable and clean energy; (h) decent work and economic growth; (i) industry, innovation and infrastructure; (j) reduced inequalities; (k) sustainable cities and communities; (l) responsible consumption and production; (m) climate action; (n) life below water; (o) life on land; (p) peace, justice and strong institution; and (q) partnerships for the goals. For the compilation of the O-TAPSE criteria catalogue, these SDGs and the 169 associated targets build the foundation to develop higher categories and assign analysis criteria to them (see Fig. 1).

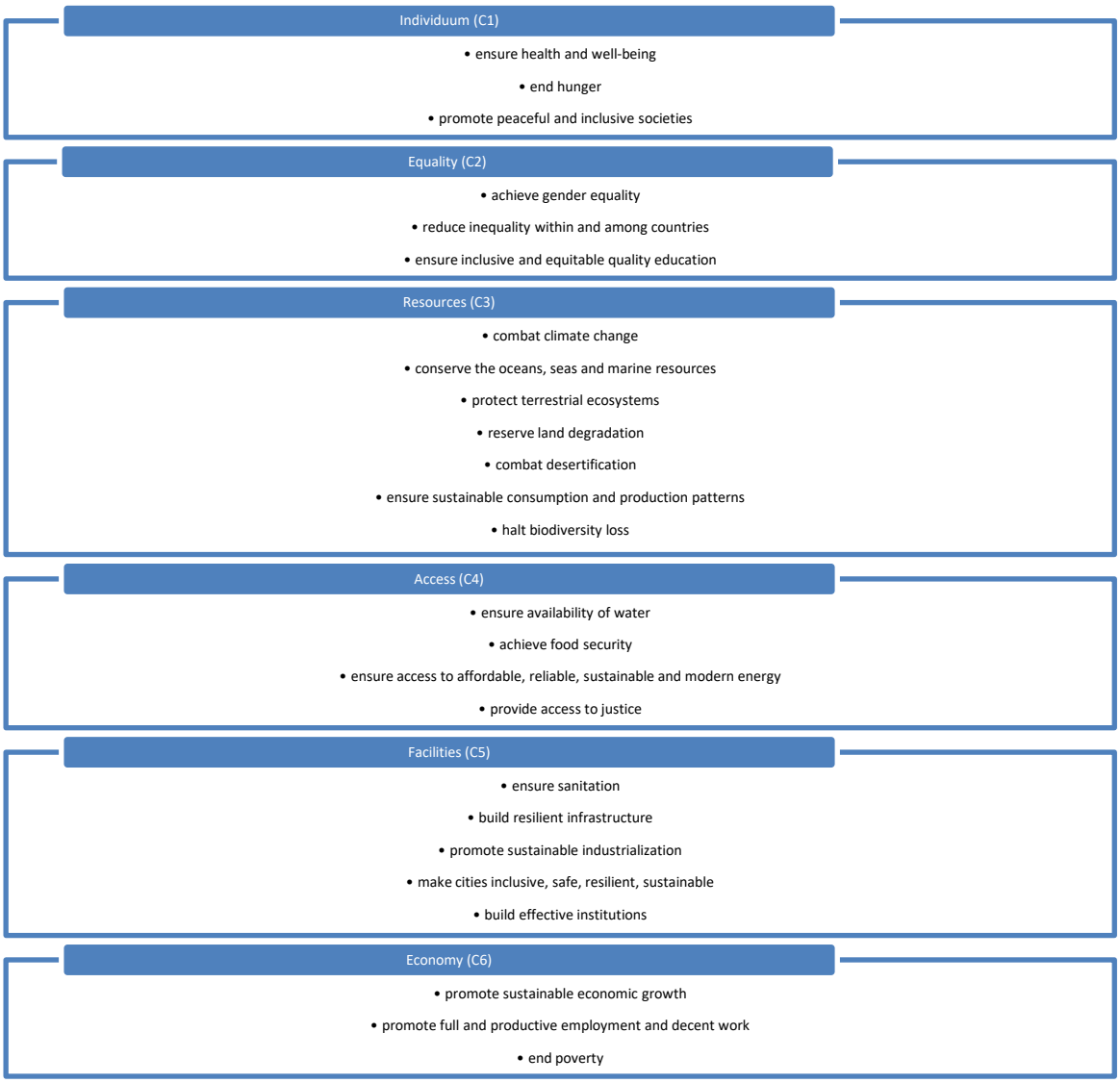


Fig. 1: O-TAPSE criteria catalogue with focus on sustainable development (developed on the basis of UN, 2015)

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III. Methodology and Questions of the Study

Based on such an understanding of sustainable development and its goals, the O-TAPSE study investigates the potentials of newly developed online tasks for activating learning in the context of sustainable development. The study is divided into three research steps (Fig. 2). In Step 1, three websites for primary school learning and teaching were selected, aiming to identify websites that have uploaded new primary science tasks over the last year. As Luxembourg and Germany – both teaching in the German language at primary schools – use similar or identical textbooks and tasks, websites were chosen that are used by both countries. This is to meet the demand set out in the 2030 agenda to consider the SDGs from a global perspective (UN, 2015).

In Step 2, all tasks on the selected websites were analyzed with regard to the appearance of contents related to sustainable development. The analysis of the tasks is based on the O-TAPSE criteria catalogue to ensure that the extensive quota of 17 SDGs and 169 targets as outlined by the UN (2015) are sufficiently taken into account without overburdening the evaluators. Therefore, the criteria catalogue with six core criteria (C1-C6; see Fig. 1) was developed against the background to compress the extensive 17 SDGs and 169 targets. The overarching objective of the analysis is to investigate the question, in which form the contents of sustainable development as listed in C1 to C6 become visible in tasks of the selected three online platforms. Four primary school teachers, two from Luxembourg and two from Germany, are included in the evaluation, all of whom have more than 10 years of experience in teaching science subjects. Within the group of teachers, the tasks are discussed with regard to the occurrence of criteria C1 to C6. In concrete terms, the evaluator group decides whether the sub-items defined in C1 to C6 are related to sustainability education (a) explicitly, (b) implicitly, or (c) do not address such content. In this context, the term "implicit" refers to potentials for tackling sustainable development contents, which, however, have to be activated by additional inputs from the teacher. In Step 2, it is indicated by the evaluators within the criteria catalogue which of the criteria and their sub-items occur in each task.

In Step 3, the evaluators comment on the sub-items that were identified in Step 2 as having potentials to activate sustainability education or as addressing it explicitly. The comments of the evaluators were written on the evaluation sheet next to the identified sub-items. The analysis was carried out on the basis of the O-TAPSE evaluation forms completed by the evaluators. All tasks of the three online platforms were compared in terms of which contents of the SDGs were addressed from the evaluators' point of view and whether these contents were perceived as implicitly or explicitly addressed.

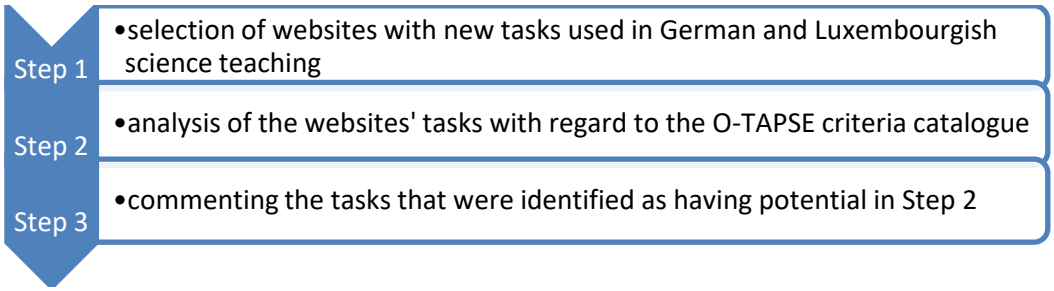


Fig. 2: O-TAPSE research design

IV. Findings: The Occurrence of Contents of Sustainable Development in Online Tasks

The evaluators selected the online platforms "Lernspiele zu den Themen Mathematik, Natur, Naturwissenschaft und Technik" (learning games on the topics of mathematics, nature, science and technology; HKM, 2020), "Kostenlose Lernspiele für die Grundschule und die Sekundarstufe I und II" (free learning games for primary schools and secondary schools I and II; DIPF, 2021) and "Materialkompass: Unterrichtsmaterialien auf dem Bildungsserver Berlin-Brandenburg" (material compass: teaching materials on the education server Berlin-Brandenburg; bbb, 2020) because they perceive these platforms as always up-to-date and often use them to extract tasks for their teaching. The group discussion has shown that contents of sustainable development could be identified in individual tasks on all three platforms. The criteria individuum (C1) and resources (C3) were identified most often, although this was almost only implicitly the case. Content of other categories (access, C4; facilities, C5) was detected less frequently and categories C2 (equality) and C6 (economy) were almost not detected at all. In the vast majority of tasks from the three online portals, however, no potentials for activating sustainability education were identified. At the same time, only very isolated tasks were identified by the evaluators that explicitly address

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contents of sustainable development. One of these tasks, explicitly addressing sustainability education, is presented below in detail in its evaluation by the evaluators.

Explicit potential for activating sustainability education was identified in the task "Unterschiedliche Energieformen" (different forms of energy; DIPF, 2021), which consists of six worksheets. Sheets 1 and 2 provide information on the various forms of energy. Seven forms of energy are presented on the basis of short descriptions. These are: "movement energy", "positional energy", "chemical energy", "radiation energy", "heat energy", "electrical energy" and "nuclear energy" (translation by author). Each form of energy is explained using examples. Sheet 3 contains six pictures showing the mentioned forms of energy (except nuclear energy); for example, a reservoir with a dam and solar cells on a roof are presented. Below the pictures are shown lines on which the corresponding energy form should be written. On Sheets 4 to 6, the cards of a memory game are depicted. Sheets 4 and 5 contain 12 picture cards that exemplify everyday applications of energy forms (e.g. windmill, cyclists riding on the road, a ski jumper at the starting position of a ski jumping hill, a plate with boiled spaghetti). Sheet 6 shows word cards with the terms "movement energy", "positional energy", "chemical energy", "radiation energy", "electrical energy" and "nuclear energy". The heat energy introduced on Sheet 2 is not found on the word cards. In the task, it is formulated that three matching cards are to be found, for each triple two pictures and a word card (e.g. picture of a windmill plus picture of two cyclists plus word card "movement energy").

In the framework of the group discussion, the evaluators rated this task as "not addressed" in relation to 22 of the total 25 sub-items. The evaluators rated two sub-items as having "potential to be addressed through additional input" and one sub-item they saw "explicitly addressed" (see Fig. 3). The two sub-items that were rated as implicitly addressed are distributed among the criteria C3 (resources) and C4 (access). The identified sub-item of category C3 refers to the content "combat climate change" and was commented by the evaluators with the addition "addressed by differentiating between renewable and non-renewable energy sources". This sub-item was rated by the evaluators as implicitly addressed. The two sub-items identified from the category access (C4) were, firstly, the content "ensure availability of water", commented by the evaluators with the addition "addressing hydropower and the kinetic energy of flowing water", which was rated as implicitly addressed in the task. Secondly, from the same category, the content "ensure access to affordable, reliable, sustainable and modern energy" was assessed as explicitly addressed, commented by the evaluators with the addition "differentiating between renewable and non-renewable energy sources and associated forms of useful energy". The overall overview results in the following findings related to the task "different forms of energy" (Fig. 3).

	not addressed	implicitly addressed	explicitly addressed
Individuum (C1)	• ensure health and well-being; • end hunger; • promote peaceful and inclusive societies		
Equality (C2)	• achieve gender equality; • reduce inequality within and among countries; • ensure inclusive and equitable quality education		
Resources (C3)	• conserve the oceans, seas and marine resources; • protect terrestrial ecosystems; • reserve land degradation; • combat desertification; • ensure sustainable consumption and production patterns; • halt biodiversity loss	• combat climate change (addressed by differentiating between renewable and non-renewable energy sources)	
Access (C4)	• achieve food security; • provide access to justice	• ensure availability of water (by addressing hydropower and the kinetic energy of flowing water)	• ensure access to affordable, reliable, sustainable and modern energy (by differentiating between renewable and

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			non-renewable energy sources and associated forms of useful energy)
Facilities (C5)	• ensure sanitation; • build resilient infrastructure; • promote sustainable industrialization; • make cities inclusive, safe, resilient, sustainable; • build effective institutions		
Economy (C6)	• promote sustainable economic growth; • promote full and productive employment and decent work; • end poverty		

Fig. 3: Evaluation of task example "different forms of energy" based on the O-TAPSE criteria catalogue

V. Discussion and Conclusion

The results of the O-TAPSE study show that there is still a great potential to anchor the SDGs in online tasks for primary school students. This is confirmed by previous studies, which found a deficient implementation of tasks to sustainability education for the field of textbooks of the subject primary science education (Andersen, 2018).The results of the O-TAPSE study give cause for urgent action, since the study used the latest tasks as analytical material and yet the SDGs were not prominently addressed, especially not in the explicit sense. There is cause for concern that the SDGs are not touched at all in the context of the majority of the tasks and, in relation to the tasks in which the SDGs are reflected, almost only in an implicit sense, so that the competence of the teaching staff is needed to actually activate a reflection on the SDGs in class. This shows that the SDGs are still under-represented in primary education tasks, as they are not touched at all in the context of the majority of newly developed online tasks and almost only implicitly in the tasks in which the SDGs shine through. Thus, it requires the competence of the teacher to actually activate a reflection on the SDGs among the students. The conclusion is that the SDGs are still not sufficiently included in the development of tasks in primary science education and that this should be more taken into account in future task profiles, especially in explicit addressing, so that SDG contents are reflected by the pupils independently of the competence of the teacher.

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