Application of Innovative Keyword Analysis Methodology within the Framework of SDGs in the 8th Grade Turkish Course Textbook

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Abstract

This study aims to enhance the contribution of education towards achieving the 17 Sustainable Development Goals (SDGs), which the United Nations (UN) describes as an urgent call for action. Education has garnered increasing interest in this regard, and this study conducts a systematic review of literature on the integration of SDG keywords into education. The study utilizes keywords from 10 relevant studies and employs a new methodology to analyze and weigh these keywords. This results in a comprehensive and robust list of keywords. The study also assesses the level of integration of SDGs in educational materials using this methodology. Furthermore, it identifies the integration level for each SDG and highlights any gaps in integration. The study offers a broad perspective on the subject by proposing a framework to guide educational institutions in integrating the SDGs into their materials. The innovative methodology allows for a measurable assessment of the integration of SDGs in education, with potential for further development and expansion.

Keywords: Sustainable development goals (SDGs), keyword analysis, education for sustainable development, integration to textbook, human development

Introduction

Sustainable development is defined as development that meets today's needs without compromising the ability of future generations to meet their own needs. This definition is commonly used to define the contemporary concept of sustainability (Halkos & Gkampoura, 2021). The United Nations Organization (UN) has been emphasizing the important role of education in the transition to a new sustainable development model since the 1990s. The role of education in promoting sustainability can be approached in two distinct ways. Firstly, by fostering the development of skills, actions, values, attitudes, knowledge, and awareness among people of all ages to ensure the conservation and protection of the environment. Secondly, by promoting economic sustainability and social equality, thereby contributing to the overall prosperity and making meaningful contributions to political and civil society through practices that enhance human knowledge (Ferrer-Estévez & Chalmeta, 2021; UNESCO, 2014). Therefore, the Education for Sustainable Development (ESD), which the UN established as the main engine of change, continues its activities with programs such as the United Nations Decade of Education for Sustainable Development (2005–2014) and the Global Action Program on Education for Sustainable Development (2015–2019) up to the present day. ESD is widely recognized as a crucial catalyst for achieving the Sustainable Development Goals (SDGs) (Figure 1). On September 25, 2015, the United Nations met in New York and collectively decided to implement 17 global Sustainable Development Goals (SDGs) with a total of 169 goals to be achieved by 2030 (UN, 2015). The fourth goal specifically includes Education for Sustainable Development (ESD). In addition, Rieckmann (2017) emphasized the necessity of proposing a new educational model that integrates the SDGs into learning through ESD.

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School is not just a place where students learn how to hold a pencil and listen to a few stories while being supervised. In contrast, the basic center of education offers experiences that expand students' worlds, stimulate their imaginations, and teach them fundamental skills such as reading, writing, and using numbers. Additionally, it encourages them to observe and engage with the world around them. School is a crucial, if not the most crucial, educational institution where students acquire the fundamental knowledge and skills that they will use throughout their lives. At the same time, it is a place in which students' collaborative capacities and interpersonal skills are developed and their positive attitudes and creative learning dispositions are fostered (Cremin & Arthur, 2014).

The world is currently facing a complex issue of sustainability between humans and the environment. However, our understanding of this issue is often incomplete and clouded by uncertainties (Voulvoulis & Burgman, 2019). People are mostly well-intentioned but are ultimately recognized as the root cause of most sustainability problems. If necessary precautions are not taken, it can exacerbate environmental, economic, and social problems (Boeve-de Pauw et al., 2015). Addressing sustainability challenges requires creating the appropriate conditions to positively influence people's behavior, attitudes, perceptions, and values. It is crucial to actively facilitate these contributions (Scoones et al., 2020; UNESCO, 2017). Fundamental changes are necessary in all essential processes and systems to achieve sustainability. In particular, education is one of the most fundamental tools to shape these processes and systems and has extraordinary potential to ensure sustainability (Cortese, 2003; IIASA, 2018). One way to promote sustainability as a lifestyle among students is to provide them with opportunities to actively engage in sustainable practices (Rauch & Steiner, 2013). For example, incorporating sustainability into the curriculum and offering hands-on experiences, such as community service projects or campus sustainability initiatives, can help students understand the importance of sustainable living and inspire them to make it a part of their daily lives. Additionally, creating a culture of sustainability on campus, through events and campaigns, can also encourage students to adopt sustainable habits. By actively involving students in sustainable practices, we can ensure that they not only learn about sustainability but also incorporate it into their lifestyle choices. Therefore, if we want to have individuals who follow this approach, the ability to understand, interpret, critically evaluate, and express opinions on sustainability should be developed in schools. To enhance this development, the course materials used to transfer these skills should be measurable. The SDGs have the potential to benefit students under various norms, but it is unclear to what extent the content and training provided to students effectively address their specific SDG concerns. It is therefore clear that it is necessary to describe and analyze the scope and depth of these materials from an SDG literacy perspective.

Figure 1

Sustainable Development Goals (UN, 2020)

Many countries are trying to achieve the SDGs by integrating them into their school curricula (Okubo et al., 2021). Turkey is not an exception and is closely monitoring these developments. However, no academic studies on integrating SDGs into a school curriculum could be found in the literature in Turkey. Moreover, incorporating the SDGs into school curricula may prove challenging, as the 17 global goals cover a diverse range of themes and encompass 169 individual targets. In addition, it is considered that many issues will arise in this regard. Kioupi and Voulvoulis (2019) pointed out that the uncertainty of measuring education efforts to achieve the SDGs is an issue. It has been reported that lack of knowledge and awareness are among the most important hindering factors in promoting ESD (Cebrián et al., 2015). It has been reported that it is difficult to incorporate SDG information into the curriculum, sometimes due to a lack of flexibility in the structure of the educational institution or a lack of time to cover the curriculum (Álvarez et al., 2021). Leal Filho et al. (2017) reported that lack of support from management, lack of appropriate technology, lack of concern and awareness, lack of an environmental committee, lack of suitable buildings, and government barriers are six general barriers to the integration of sustainability. In addition, lack of resources such as knowledge, time, or funding, an overcrowded curriculum, perceived threats to academic integrity or freedom, seeing sustainable development as irrelevant in some disciplines, and resistance to change were also highlighted as problems (Verhulst & Lambrechts, 2015).

A detailed examination and evaluation are needed to identify and overcome these problems. Therefore, it is very important to identify issues and examine the subject in detail before integrating the SDGs into the school curriculum.

An analysis of the literature highlights the fact that there are currently a limited number of frameworks for systematically applying the SDGs in schoolbooks. This paper has addressed a methodology for addressing this gap by examining the many focuses and commitments currently in the schoolbooks for the SDGs. Building on the results of this methodology, this document produces a perspective for the SDGs as a whole and a framework that can help facilitate the inclusion of specific objectives in schoolbooks. In this study, the frequency of usage of international

premises for sustainability in the specified teaching textbook has been determined. The contribution of this article is that it stands before us as one of the first articles to make an assessment and draw a general framework for the more systematic introduction of SDGs in schoolbooks. The fact that a common word pool has been created by taking into account the studies related to the field to date is the unique contribution of the study to the field.

Method

Textbook Selection

In this study, analysis of the Turkish course textbook with more vocabulary and narrative content than other courses was chosen in terms of the analysis of the SDG objectives content. It was thought that the Turkish course would be more comprehensive in conveying and reflecting the SDG objectives since it contains comprehension and expression. In addition, the 8th-grade Turkish course book, which was taught to 8th-grade students who have a higher perception level depending on age, was chosen as a book for analysis in the study. The 8th-grade Turkish textbook used in the study was published in 2021 and was accepted as a textbook with the decision of the Ministry of National Education, Board of Education and Discipline, dated July 25, 2018, and numbered 99 (Eselioğlu et al., 2021).

Keywords Analysis

First, a way had to be found to evaluate the book to be reviewed against the different SDG objectives. Some lists representing 17 SDG goals, 169 targets, and 232 indicators have been created in the literature, but it has been seen that there is no standard list and these lists are open to expansion. Therefore, a variable keyword list with strong SDG representation capability has been developed. Keywords associated with a document can provide important information about the topics that the document addresses (Shubankar et al., 2011). Firstly, In order to see the size of the SDGs in the content of the books examined, the sources that deal with the keywords for all SDGs have been searched in the literature. In this context, 10 different sources (Belmonte-Ureña et al., 2021; Elsevier, 2021; Hueske et al., 2021; ITS, 2021; Mistry, 2020; Moallemi et al., 2020; Monteiro et al., 2019; Osman et al., 2017; UoA, 2021; Whittingham et al., 2022) were found for SDG keywords. The found SDG lists are combined in a single Microsoft Excel file. Using Microsoft Excel and MAXQDA programs, the number of repetitions of keywords for SDGs was determined (Table 1). However, when the keywords have been analyzed on a word-by-word basis, it has been seen that some words remained in the background within the keywords' collocation. Thereupon, the number of repetitions of SDG keywords has also been determined on a word-by-word basis (Table 2). A new list has been created for the keywords (K) that repeat three or more times. In addition, a new list has been created for words that repeat 5 or more times from the words of the keywords (KW). The lists of all SDGs were then normalized to 0–1 with Equation 1 for balanced scoring.

$$Z = \frac{x - min(x)}{max(x) - min(x)} \quad (1)$$

Weighted keyword values have been calculated with the normalized K_N and KW_N lists. If the keyword consists of a single word, the weighted value of the keyword is found by multiplying the normalized value of the word in the K list with the normalized value of the word in the KW list (Eq. 2).

$$K_w = K_N \times KW_N \quad (2)$$

If the keyword consists of a single word and is not in the KW list, the weighted value of the keyword is found by multiplying the normalized value of the word in the K list with the minimum KWN value in the KW list

and the number of repetitions in the K list (3 or 4) and dividing by the minimum number of KW repetitions (5) (Eq. 3).

$$K_w = K_N \times K_{minN} \times \frac{3\ or\ 4}{5} \quad (3)$$

If the keyword consists of multiple words, after multiplying the normalized values of the words in the K and KW list, the results are summed to find the weighted value of the keyword (Eq. 4).

$$K_w = \sum_{i=1}^{n} \left(K_{N_i} \times KW_{N_i}\right) \quad (4)$$

If the keyword consists of multiple words and the keywords are not in the KW list, the values are summed up by applying equation 3 to each word (Eq. 5).

$$K_w = \sum_{i=1}^{n} \left(K_{N_i} \times KW_{minN} \times \frac{3\ or\ 4}{5}\right) \quad (5)$$

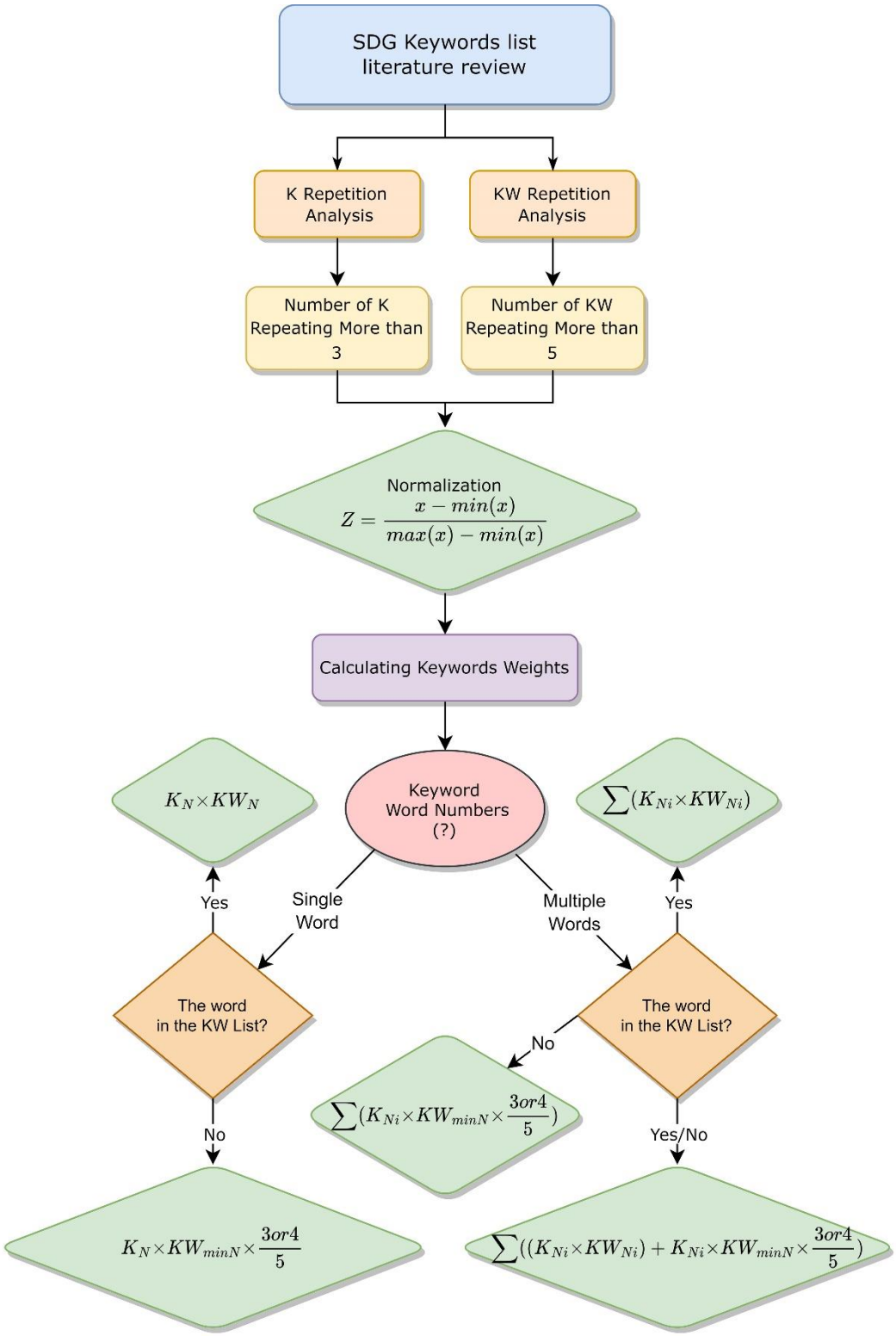
If some of the Keyword collocation words are not in the KW list, equation 3 for those not in the list and equation 2 for those in the list are applied, and all results are summed (Eq. 6).

$$K_w = \sum_{i=1}^{n} \left(\left(K_{N_i} \times KW_{N_i}\right) + K_{N_i} \times KW_{minN} \times \frac{3\ or\ 4}{5}\right) \quad (6)$$

The selection of the keywords to be used and their weighting have been done as shown in the flow chart (Figure 2).

Figure 2

Flowchart of Creating Lists of Keywords for Weighted SDGs



Data Collection and Analysis

SDG analysis on the specified textbook has been done with the MAXQDA software program. After the examination has been completed, the data obtained have been evaluated with descriptive analysis. The quantitative data

obtained has been divided into categories and tabulated. Descriptive analyses of the quantitative data have been made and presented under the relevant tables. There are eight themes in the examined textbook. In the examined textbook, the contents section and the previous general book literature have been excluded, and all texts within the themes have been included in the research. The analysis of the texts in the examined textbooks has been classified according to the evaluation scale developed in this study.

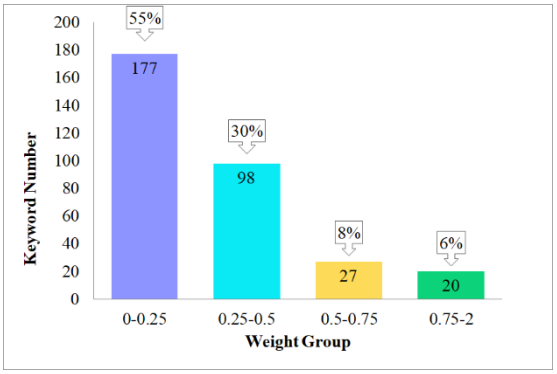
Findings

When the scenario in the flowchart in Figure 2 was applied with this new CARE keyword weighting method, a new SDGs keyword list with high representative power was created. In addition, since it is a weighted keyword list, it has become a method that reveals how much it represents the relevant subject. Keywords contribute to the large-scale search for units of meaning from a linguistic point of view (Sinclair, 2004). From this point of view, strong keywords are needed to express a subject in a text, and it can also be measured how much any text presents the desired subject with strong keywords that represent that subject. Bondi and Scott (2010) stated that keywords are the tips of icebergs. For this reason, in this study, firstly, the keywords that have been used in the literature for SDGs were collected. Then, the words with prominent representation power have been determined. Finally, each keyword has been weighted with a new method according to the frequency of its occurrence in the lists in the literature. This weighted keyword list has been applied to a selected textbook. In this way, it has been tried to quantitatively reveal how much SDG is covered in the 8th-grade Turkish Textbook.

Keywords have been mainly weighted between 0 and 1. Bringing the data between certain values is an important step to obtaining good classification performance (Singh & Singh, 2020). However, the frequent repetition of some words has carried the weight score of keyword collocation above 1. A total of 322 keywords have been included in the new list of 17 SDGs. The minimum weight score of the keywords has been calculated as 0.053 and the maximum as 2. Since the listing has been made according to the condition of 3 repetitions as keywords and at least 5 repetitions as words, the weights are over 0. Keywords have been divided into four weight groups (Figure 3): priority representation (2-0.75), strong representation (0.75-0.5), average representation (0.5-0.75), and little representation (0.25-0). Looking at the identified keywords by weighting groups, there's about one keyword in Priority representation, about 3 keywords when we include strong representation, about 9 keywords when we include average representation, and about 19 keywords when we consider them all in each SDG.

Figure 3

Distribution by Weight Groups

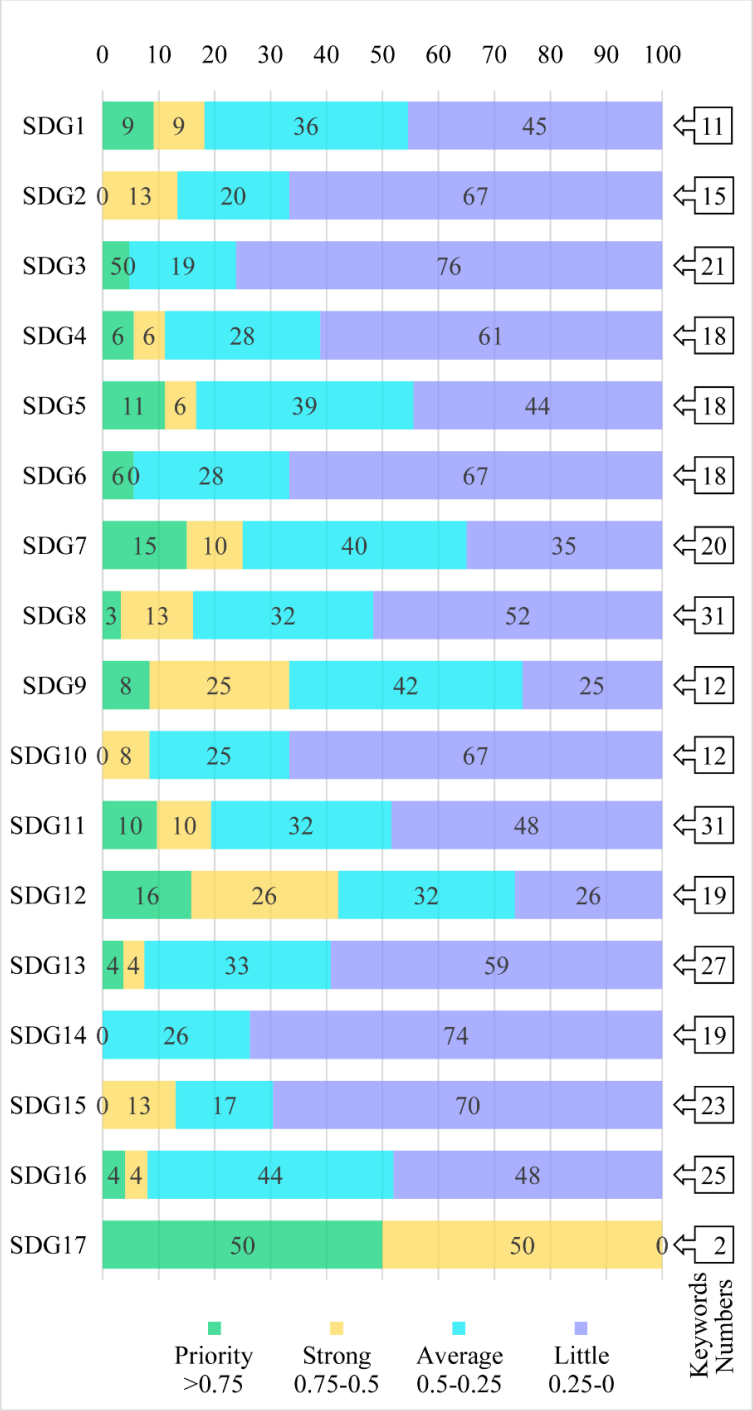


SDGs have between 11 and 31 keywords, excluding SDG17 (2), with a median average of 19. In the newly created list, there are no keywords in the Priority representation weight range in SDG2, SDG10, SDG14, or SDG15. It was

observed that there was no keyword in SDG3, SDG6, and SDG14 in the strong representation range, and in SDG17 in the average representation and little representation range. It is seen that there are only two weight ranges of keywords in SDG14 (average and little representation) and SDG17 (priority and strong representation). Figure 4 shows the proportional distribution of the weighted keywords of the SDGs. Figure 4 makes it easy for us to infer the power of keywords that represent the SDGs. The representativeness of the keywords may also be related to familiarity with the SDG topic. Keyword analysis has become more and more important, providing insight into the actual content of research topics and reducing effort and time (Weismayer & Pezenka, 2017).

Figure 4

Proportional Distribution of Weighted Keywords of SDGs



In Table 1, 10 different SDG keyword lists found in the literature are tabulated according to the number of repeats. Keywords with three or more repetitions have been added to the table in order to produce a strong and new list. In this way, keywords accepted by at least three different sources have been used. It is seen that the keywords are used in a maximum of eight pieces of literature. It has been determined that there are keywords for each SDG up to 5 replicates except SDG 17. Shubankar et al. (2011) have conducted an algorithm study on frequently used keywords for topic modeling and clustering. They have stated that frequently used keyword sets have been created based on a user-defined minimum value.

When 10 different SDG lists were examined, two lists mostly used one keyword, and for some SDGs, two or three keywords have been used. More than two keywords have been used in other lists [data]. When the keyword list prepared by Osman et al. for SDGs is examined among these 10 literature lists, it is seen that one keyword was chosen for each SDG and only two keywords were selected for SDG 12. Among the keywords determined by the author, SDG11 "*cities*" and SDG15 "*ecosystems*" are repeated four times, and the others are repeated five or more times. In fact, "ecosystem" has eight repetitions when the plural suffix is not taken into account. It can be thought that the author has chosen an effective keyword sequence from here. Including a suitable keyword list in a document will ensure that the document spreads to relevant groups and can have a high impact (Uddin & Khan, 2016). When more detailed and comprehensive scoring is desired, it is clear that the keywords selected and scored with the new method determined in this study will reveal in more detail how many SDGs are mentioned.

Some of the keywords consist of more than one word. It is noteworthy that some words are used a lot in different groups. For this reason, Table 2 was created from words with 5 or more repetitions in the selected literature list, taking into account the repetitions on a word basis. On this occasion, the positive contribution of the words, which have a strong expression alone, to the keywords has been added with the new method in this study. While the keywords "*poverty*" and "*water*" have been repeated 8 times, they have been used as words 37 and 216 times within the keywords, respectively. While the keywords "*health*" and "*education*" have been repeated six times, they have been used as words 63 and 110 times in the keywords, respectively. According to the number of repetitions of the words in Table 2, additional power was provided to the keywords. In this way, it has been tried to reveal the realistic representation power of the keywords. In Table 2, the plural forms of the words are given separately, but their plural and singular forms are evaluated together in scoring. While keywords have a maximum of 8 repetitions, the rate of words with 9 or more repetitions on a word basis in Table 2 has a share of approximately 42%. This situation reveals the importance of Table 2.

Table 1

Recurring SDG Keywords in at Least Three Literature from 10 Selected Literature Sources

Repetition	**8**	**7**	**6**	**5**	**4**	**3**
SDG1	poverty			social protection	microfinance	disadvantaged, extreme poverty, income, poor, poverty alleviation, poverty eradication, poverty line, vulnerable
SDG2		hunger		food, malnutrition	agriculture, crop, crops, food security, nutrition	agricultural, agricultural productivity, food gap, food production, malnourished, small-

						scale food producers, stunting, undernourished
SDG3			health	aids, hiv, malaria	hepatitis, maternal mortality	alcohol abuse, antiretroviral therapy, child deaths, contraceptive use, diseases, epidemic, family planning, measles, mental health, mortality, polio, sexual health, substance abuse, tuberculosis, water-borne disease
SDG4			education	school	primary education, school enrolment, vocational training	basic education, early childhood development, education reform, equal education, learning, learning opportunities, lifelong learning, literacy skills, secondary education, skills, teacher training, training, universal education
SDG5		gender, women		female genital mutilation	feminism, reproductive rights, sexual violence	empower girls, empowerment, equality, forced marriage, gender discrimination, gender equality, human trafficking, marginalised, sexual and reproductive health, sexual exploitation, violence, violence against women
SDG6	water	sanitation		hygiene, wastewater	desalination, water quality, water scarcity, water supply	aquifer, contaminated, defecation, fresh water, irrigation, recycled water, river, untreated wastewater, waste water, wastewater treatment, water harvesting

SDG7		clean energy, energy, renewable energy	energy efficiency, hydroelectric, renewable	solar, solar power, wind power	affordable energy, alternative energy, clean energy technology, clean fuel, clean fuel technology, clean fuels, reliable energy, renewable power, sustainable energy, wind, wind energy, wind turbine
SDG8	employment	economic growth	labour market	growth, job creation, labor, safe work, unemployment	child labour, child soldiers, decent work, economic productivity, entrepreneurship, financial services, forced labour, global trade, human trafficking, inclusive economic growth, labour, labour rights, micro finance, migrant workers, modern slavery, productive employment, quality jobs, secure work, stable employment, stable jobs, sustainable economic growth, sustainable tourism, work opportunities
SDG9		infrastructure, innovation		resilient infrastructure	environmentally sound technologies, industrial diversification, internet access, manufacturing, sustainable industrialisation, sustainable infrastructure, technological capabilities, technology, transborder infrastructure

SDG10		inequality		equal opportunity, income inequality, inequalities	ageism, development assistance, disabilities, discrimination, ethnicity, homophobia, inclusion, sexism, social inclusion, social protection
SDG11		urbanization	cultural heritage, slums, urban	cities, housing, public spaces, public transport, smart cities, town planning, transport, urban development, urban planning	air pollution, air quality, development planning, disaster management, disaster risk reduction, disaster strategy, fine particulate matter, green spaces, human settlements, inadequate housing, informal settlements, natural disasters, natural heritage, pollution, resilient buildings, sustainable urbanisation, urban sustainability, waste
SDG12			circular economy, natural resources, production, resource efficiency, sustainable consumption		consumption efficient use of resources, energy efficiency, food, food waste, overconsumption, recycling, responsible production chains, sustainable, sustainable production, sustainable tourism, waste, waste management, wasteful consumption
SDG13	climate change		global warming, greenhouse gas	climate, emissions, global temperature, greenhouse gases	carbon footprint, climate action, climate adaptation, climate change planning, climate change policy, climate early warning, climate hazards, climate impact, climate mitigation, climate related hazards,

					CO_2 capture, COP 21, COP 22, extreme weather, ice loss, ocean warming, Paris agreement, sea level, temperature, warming
SDG14		fisheries, ocean	marine, ocean acidification, overfishing	coral reef, marine pollution, oceans	acidification, aquaculture, coral bleaching, fish species, fish stocks, fishery, fishing, fishing practices, illegal fishing, marine ecosystems, marine resources, productive oceans, sea grasses
SDG15	biodiversity		conservation, desertification, reforestation	afforestation, ecosystem, ecosystems, forest, invasive species, threatened species, wildlife	biodiversity loss, deforestation, ecosystem restoration, forest management, forests, illegal wildlife products, land, land loss, land use, poaching, protected fauna, protected flora, soil degradation, species
SDG16		violence	corruption, justice, peace	bribery, organized crime, sexual abuse	accountable institutions, arbitrary detention, arms trafficking, birth registration, combat terrorism, governance, human rights, human trafficking, illegal arms, illicit financial flows, inclusive institutions, institutions, Paris principles, physical abuse, psychological abuse, rule of law, sexual violence, torture
SDG17					international cooperation, knowledge sharing

Table 2

Word Repetition of Selected Keywords for SDGs in the 10 Reviewed Literature Sources

SDGs	≥10	9	8	7	6	5
SDG1	poverty(37), social(27), protection(12), income(10)		poor, vulnerable	financial	child, development, extreme, welfare	aid, alleviation, countries, developing, economic, low, reduction
SDG2	food(71), agricultural(23), agriculture(14), diversity(14), nutrition(13), security(13), crop(12), production(11), genetic(10), hunger(10)	management	farming, land, malnutrition, nutritional	sustainable	development, insecurity, market, productivity, scale, smallholder, soil, supply, system, undernutrition	chain, crops, household, organic, risk, small, status
SDG3	health(63), disease(35), mortality(22), care(17), abuse(11), child(10)	death	rate, use	alcohol, cancer, maternal, mental, substance	access, deaths, heart, hiv, human, malaria, sexual, water	aids, cardiovascular, diabetes, diseases, drug, lung, neonatal, respiratory, syndrome
SDG4	education(110), learning(31), school(26), educational(18), early(15), training(15), childhood(14), skills(13), teacher(12), development(11), literacy(11), primary(10)	gender, reform, secondary	access, basic, vocational		disparities, enrolment, environment, equal, global, opportunities, professional, special	achievement, developing, higher, inclusive, numeracy, policy, quality, student, teaching
SDG5	gender(46), women(38), sexual(35), violence(29), female(24),			genital	abuse, discrimination, empower, human, marriage ,work	feminism, forced, mutilation, physical, trafficking

	reproductive(18), rights(16), women's(14), empowerment(13), girls(13), health(13), equality(12), exploitation(11)					
SDG6	water(216), treatment(33), sanitation(31), wastewater(29), quality(24), hygiene(23), drinking(21), management(20), freshwater(18), supply(16), aquatic(11), resource(11), groundwater(10), pollution(10), waste(10)	clean	efficiency, resources, use	desalination, ecosystems, irrigation, river	ecosystem, scarcity, toilet	access, aquifer, contaminated, contamination, defecation, harvesting, membrane, plants, safe, sewage, sustainable
SDG7	energy(118), wind(42), power(33), renewable(27), clean(22), solar(22) fuel(20), technology(14), turbine(13), electricity(12), storage(11)	electric, hybrid, smart, sustainable	battery, cells	efficiency	development, fossil, hydroelectric	consumption, conversion, fuels, generation, ion, modern, offshore, vehicles
SDG8	economic(48), growth(41), employment(28), labour(25), development(21), sustainable(18), tourism(17), work(17), productivity(15), trade(14),	domestic, economy, global, labor, small	micro, unemployment	child, enterprises, gdp, gross, occupational, product, youth	decent, equal, medium, safe, stable	efficiency, environmental, human, inclusive, quality, rate, slavery, workers, working

	financial(12), policy(12), job(11), jobs(10), market(10)					
SDG9	infrastructure(35), innovation(26), industrial(22), manufacturing(15), technology(15), development(14), access(13), sustainable(13)		internet, technologies	information	industry, investment, technological	clean, industrialisation, policy, research, resilient, transportation, value
SDG10	social(33), inequality(21), economic(14), health(14), financial(13), migration(13), human(11), inequalities(10)	income, rights	foreign, inclusion, international, policy	assistance, development, disparities, equal, immigration, investment, sexism, socioeconomic	developing, discrimination, equality, protection	disabilities, emigration, migrant, policies, remittance, trade
SDG11	urban(47), air(43), waste(25), pollution(23), planning(19), public(19), quality(19), disaster(17), sustainable(16), transport(16), solid(15), development(14), cities(13), heritage(13), management(13), municipal(13), city(12), housing(12), smart(11)	risk	natural, spaces, traffic, transportation	buildings, matter, particulate, reduction	ambient, building, disasters, land, local, monitoring, settlements, treatment, wastewater	cultural, green, resilient, road, slums, space, strategy, transit, urbanisation, water

SDG12	waste(50), sustainable(41), energy(23), consumption(22), food(19), management(19), resource(17), production(16), solid(14), environmental(13), efficiency(12), use(12), resources(11), economy(10)	municipal	cycle, supply	circular, fuel, hazardous, life, natural, tourism, treatment	development, material, pollution, procurement, recycling	assessment, chain, corporate, efficient, fossil, generation, losses, sustainability, water
SDG13	climate(140), change(43), carbon(19), global(19), emissions(18), sea(17), greenhouse(16), warming(15), CO_2(14), gas(13), adaptation(12), level(11), temperature(11), reduction(10)	mitigation		capture, dioxide, emission, ice, impact, policy, risk, weather	anthropogenic, cop, extreme, hazards, ocean	disaster, environmental, gases, Paris, planning
SDG14	marine(62), coastal(23), fisheries(20), fish(16), fishing(15), management(15), ocean(15), coral(13), sea(11), oceans(10)		acidification, ecosystem, ecosystems, reef	areas, pollution	biodiversity, fishery, protected, resources, species	aquatic, overfishing, stocks, water
SDG15	species(44), land(32), biodiversity(20), ecosystem(19), forest(19), conservation(16),	degradation, loss, management, restoration	forests, index	terrestrial, use	freshwater, threatened, water	alien, biological, change, desertification, mountain, plant, reforestation

	soil(15), cover(12), wildlife(12), ecosystems(11), environmental(11), protected(11), invasive(10), vegetation(10)					
SDG16	violence(31), abuse(20), sexual(17), rights(16), human(15), crime(14), justice(13), conflict(12), corruption(11), arms(10), institution(10), institutions(10), political(10), war(10)	decision, freedom, inclusive, law, physical	participation, public	making, societies, trafficking	child, criminal, democratisation, engagement, illicit, peace, society, terrorism	bribery, involvement, organized, participatory, peaceful, rule, violent
SDG17	cooperation(10), international(10)	development	partnerships			global, technology

Innovative Keyword Analysis Methodology: Analysis of the Secondary School 8th-Grade Turkish Lesson Textbook within the Framework of Sustainable Development Goals

When the SDG keywords obtained with the new method in the study were searched in the 8th grade Turkish textbook, the result shown in Figure 5 was revealed. The original SDG color codes are used in Figure 5 to facilitate understanding. The number of keywords for each SDG and how many times each keyword is repeated in the textbook examined are given numerically next to the relevant SDG and the keyword. If the keywords in the textbook are less than 10, they are shown on the outside of the relevant SDG symbol; if they are 10 or more, they are shown on the inside of the relevant SDG symbol. In the study, it is seen that some keywords (food, waste) are used to represent more than one SDG. The keyword *food** shown in SDG 2 in the figure covers all kinds of food, while the keyword *food* in SDG12 only shows the literal meaning of the word food. A difficulty was encountered here, as the study was carried out on a book written in Turkish. Translation is not just about conveying the abstract meaning of a word; it is more about conveying what is meant in discourse (Akan et al., 2019). Just as each language has words with close meaning in it, when the word is translated into another language, it is seen that there is more than one word to match that word. In the study, all words that meet the meaning of the relevant keyword in Turkish were taken into account.

Figure 5

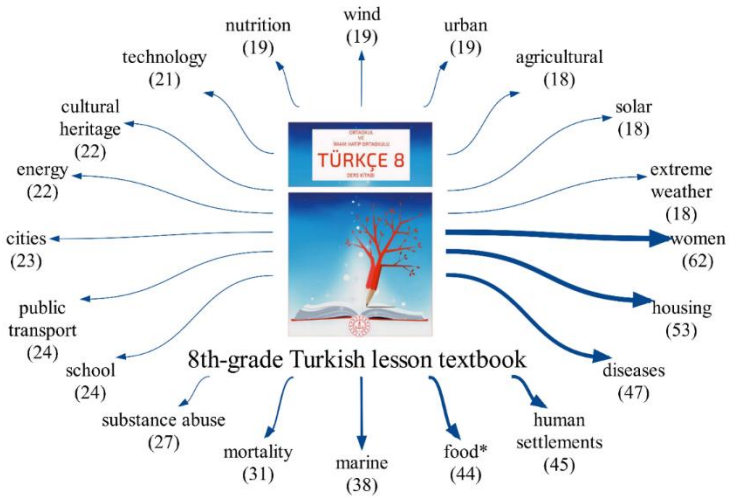
The Repetition of the SDG Keywords Selected According to the New Method in the Textbook Examined

In Figure 6, the 20 most repetitive keywords in the examined textbook are shown. This figure essentially provides a summary representation of the density structure of the SDGs in the textbook under review. 186 of these keywords are SDG11, 105 are SDG3, 81 are SDG2, 59 are SDG7, 62 are SDG5, 38 are SDG14, 24 are SDG4, and 21 belong to SDG 9. The most recurring keywords were not included in the other nine SDGs. It was determined that 6 (*housing, human settlements, public transport, cities, cultural heritage,* and *urban*) of these 20 keywords belong to SDG11, 3 keywords each in SDG3 (*diseases, mortality, substance abuse*), SDG2 (*food*, nutrition, and agriculture*), and SDG 7 (*energy, wind, and solar*), and one word in SDG5 (*women*), SDG14 (*marine*), SDG4 (*school*), and SDG9 (*technology*). It has been determined that the most repetitive keywords represent approximately 50% of the SDGs. If you look at

these 20 keywords in general, it is clear that they contain very important and current issues for a truly sustainable life.

Figure 6

The 20 Most Repetitive Keywords and Their Repetitions in the Textbook Examined

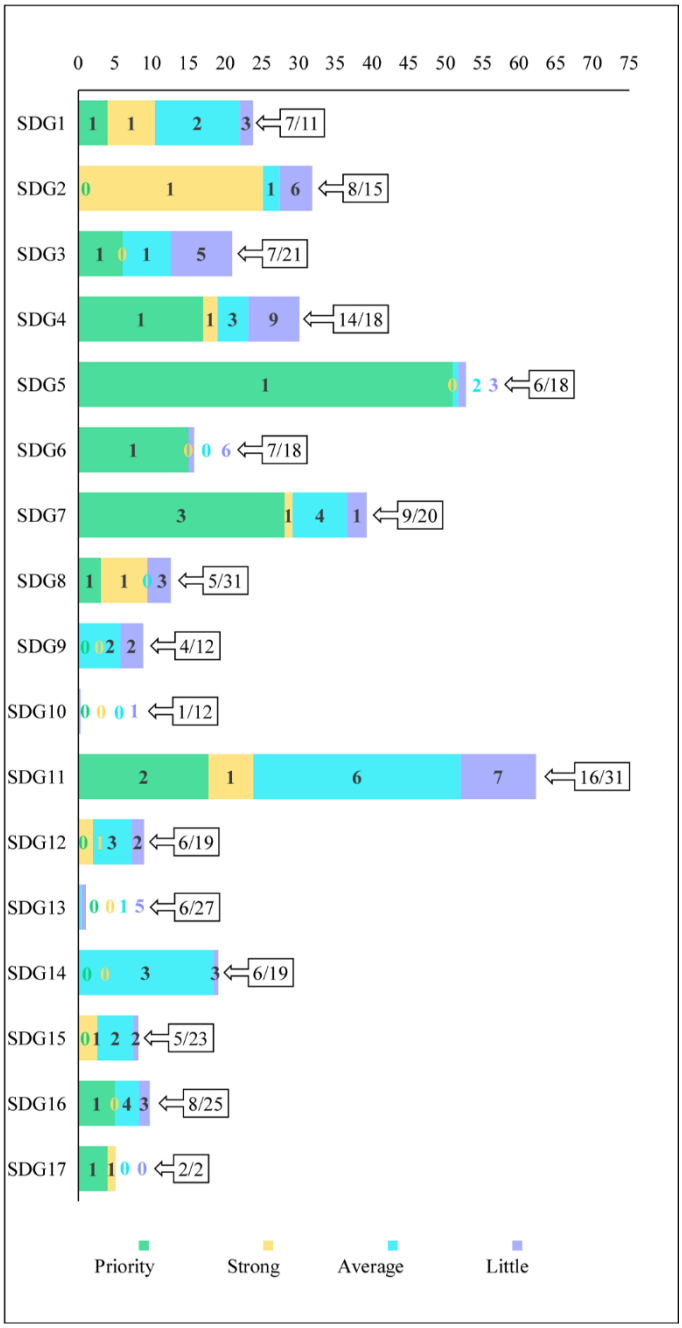


Discussion

It has been determined that each SDG is more or less included in the 8th-grade Turkish textbook under review. Considering the usage status of the keywords determined by the new method, it was seen that all of the keywords (two keywords) determined for SDG17 have been used. However, two keywords are considered to be understaffed for this SDG. It is therefore clear that strong new keywords need to be developed for this SDG. In addition, it was determined that more than 50% of the keywords determined in SDG4-1-2-11 (78%, 64%, 53%, and 52%, respectively) have been included in the book examined. Nearly 50% of the determined keywords in SDG7 and SDG6 have been used (45% and 39%, respectively). While this rate is 33% in SDG3-5-9, it is 32% in SDG16-12-14. It is thought that it will not be possible to use all SDG keywords in all textbooks due to their subject and field. However, it is considered that at least 30% of the keywords can be used for each SDG. Their usage rate is 22% in SDG13-and 15 (6 and 5 keywords, respectively), 16% (5 keywords) in SDG8, and 8% (1 keyword) in SDG10. It is thought that the keyword usage rate should be kept above 30%. In addition to the usage rate of the keywords, the weight level and repetition of the keywords significantly affect their power to represent the relevant SDG. In the book examined in Figure 7, the level of representation of each SDG is determined by the new method developed and shown.

Figure 7

New SDG Keywords Determined by Weight Groups in the Turkish Textbook, Their Scores, and Ratios (If the number of keywords is in its own region, it is shown in black; if not, it is shown in its own group color, respectively.)



It was determined that the highest representation was in SDG11 with 62.3 points. Afterward, it was observed that there was a score order of SDG5 52,8; SDG7 39,3; SDG2 31,8; SDG4 30,1; SDG3 20,9; SDG14 19,0; SDG1 17,3; SDG6 15,7; SDG8 12,6; SDG16 9,7; SDG12 8,9; SDG9 8,8; SDG15 8,2; SDG17 5,1; SDG13 1,0; SDG10 0,3 from largest to smallest (Figure 7). It is seen that 10 of the 17 SDGs are represented with a score greater than 10 and 7 of them with a score less than this value. There is also an underrepresentation in SDG 17, but it is thought that the level of representation for SDG 17 is underestimated due to the lack of keywords. In Figure 7, it is seen that only one keyword from the priority representation group in SDG 4-5-6-7-11, which is the first to stand out, represents the relevant SDG by more than 10 points. These keywords and their scores are *education* 17, *women* 51, *water* 15, *energy*

22, and *urban* 15, respectively. Here, the fact that the keyword *women* gets a score more than twice that of the *energy* keyword reveals that there is positive discrimination against women in the examined book. In fact, these five keywords are the key words that the whole world has focused on.

When the keywords that alone score 10 or more are examined, it is seen that the keyword food* from the strong representation weight group achieved 25.1 points with 44 repetitions. It is seen that the marine and public transport keywords from the average representation weight group achieved 16.9 and 10.3 points with 38 and 24 repetitions, respectively. It has been determined that the number of keywords that scored between 5 and 10, 1–5, and 0–1 points alone has 9, 41, and 59, respectively. It has been determined that no points could be obtained from the 206 keywords determined by the new method in the examined textbook. Details and calculations of the data used in this study are available online.

When Figure 7 is analyzed according to representation weight groups in priority representation, it is seen that 5 SDGs score 10 and above, 2 SDGs score between 5 and 10, 3 SDGs score between 1 and 5, and 7 SDGs score 0. In the strong representation group, it is seen that 1 SDG scores 10 and above, 3 SDGs are between 5 and 10, 5 SDGs are between 1 and 5, and 8 SDGs are 0. In the average representation group, it is seen that 3 SDGs score 10 and above, 4 SDGs score between 5 and 10, 4 SDGs score between 1 and 5, 2 SDGs score between 0 and 1, and 4 SDGs score 0. In the little representative group, it is seen that 1 SDG is 10 and above, 2 SDGs are between 5 and 10, 8 SDGs are between 1 and 5, 5 SDGs are between 0 and 1, and 1 SDG is 0. When an evaluation is made in general, it is seen that the keywords of priority, strong representation, and average representation come to the fore in the textbook examined. However, it is seen that the little representation also earns undeniable points.

Conclusion

Within the scope of the SDGs by the United Nations, quality education for sustainable development is accepted as both an aim and the most fundamental tool for the achievement of sustainable development. In line with this information, for the integration of SDGs into education, the keywords in the literature were collected and a weighted keyword list was created. With the new weighted SDG keywords, the integration of the 8th grade Turkish textbook with the SDGs was analyzed. With the innovative analysis method, it was concluded that the weights of the keywords obtained as a result of the current research were collected on topics that are frequently on the agenda in the current world. Although there are some academic studies on the integration of SDGs into educational materials in the literature, it has been observed that there is no study on the level of integration. It is clear that the proposed method will lead to current studies since it is improvable and renewable. In addition, since the analysis results also show the SDG integration deficiencies, the innovative method is a method that strengthens the integration by closing the deficiencies. Moreover, the current analysis is capable of developing a framework that can provide guidance for achieving the SDGs and promoting sustainable development. Therefore, this developed method is a toolkit for organizations or educational institutions striving for the integration of the SDGs. It is important to highlight some of the limitations of the study. The study was created with 10 lists available in the literature. It is possible to develop and expand these lists. In addition, as a second constraint, the analysis of keywords in English in a different language brings difficulties in word-meaning matching. This study can be used to integrate SDGs into educational materials, or the new weighted SDG keyword list created in the new study can also be used as a reference.

References

Akan, M. F., Karim, M. R., & Chowdhury, A. M. K. (2019). An analysis of Arabic-English translation: Problems and prospects. *Advances in Language and Literary Studies*, *10*(1), 58-65. https://doi.org/10.7575/aiac.alls.v.10n.1p.58

Álvarez, I., Etxeberria, P., Alberdi, E., Pérez-Acebo, H., Eguia, I., & García, M. J. (2021). Sustainable civil engineering: Incorporating sustainable development goals in higher education curricula. *Sustainability*, *13*(16), 8967. https://doi.org/10.3390/su13168967

Belmonte-Ureña, L. J., Plaza-Úbeda, J. A., Vazquez-Brust, D., & Yakovleva, N. (2021). Circular economy, degrowth and green growth as pathways for research on sustainable development goals: A global analysis and future agenda. *Ecological Economics*, *185*, 107050. https://doi.org/10.1016/j.ecolecon.2021.107050

Boeve-de Pauw, J., Gericke, N., Olsson, D., & Berglund, T. (2015). The effectiveness of education for sustainable development. *Sustainability*, *7*(11), 15693-15717. https://doi.org/10.3390/su71115693

Bondi, M., & Scott, M. (2010). *Keyness in texts* (Vol. 41). John Benjamins Publishing. https://doi.org/10.4000/asp.4932

Cebrián, G., Grace, M., & Humphris, D. (2015). Academic staff engagement in education for sustainable development. *Journal of Cleaner Production*, *106*, 79-86. https://doi.org/10.1016/j.jclepro.2014.12.010

Cortese, A. D. (2003). The critical role of higher education in creating a sustainable future. *Planning for higher education*, *31*(3), 15-22.

Cremin, T., & Arthur, J. (2014). *Learning to teach in the primary school*. Routledge. https://doi.org/10.4324/9781315812960

Elsevier. (2021). *Universities, societal impact & sustainable development*. Elsevier. Retrieved 02.11.2023 from https://www.elsevier.com/__data/assets/pdf_file/0003/1175358/societal-impact-sustainable-development.pdf

Eselioğlu, H., Set, S., & Yücel, A. (2021). *Ortaokul ve imam hatip ortaokulu Türkçe 8 ders kitabı* (A. Yücel, Ed. Vol. Milli Eğitim Bakanlığı Yayınları:6986). Milli Eğitim Bakanlığı (MEB).

Ferrer-Estévez, M., & Chalmeta, R. (2021). Integrating Sustainable Development Goals in educational institutions. *The International Journal of Management Education*, *19*(2), 100494. https://doi.org/10.1016/j.ijme.2021.100494

Halkos, G., & Gkampoura, E. C. (2021). Where do we stand on the 17 Sustainable Development Goals? An overview on progress. *Economic Analysis and Policy*. https://doi.org/10.1016/j.eap.2021.02.001

Hueske, A.-K., Pontoppidan, C. A., & Iosif-Lazar, L.-C. (2021). Sustainable development in higher education in Nordic countries: exploring E-Learning mechanisms and SDG coverage in MOOCs. *International Journal of Sustainability in Higher Education*. https://doi.org/10.1108/IJSHE-07-2020-0276

IIASA. (2018). Transformations to Achieve the Sustainable Development Goals. In: IIASA Laxenburg, Austria.

ITS. (2021). *Daftar keywords Sustainable Development Goals (SDGs)*. Institut Teknologi Sepuluh Nopember. Retrieved 02.11.2023 from https://www.its.ac.id/drpm/wp-content/uploads/sites/71/2021/04/Daftar-keywords-Sustainable-Development-Goals.pdf

Kioupi, V., & Voulvoulis, N. (2019). Education for Sustainable Development: A Systemic Framework for Connecting the SDGs to Educational Outcomes. *Sustainability*, *11*(21). https://doi.org/10.3390/Su11216104

Leal Filho, W., Wu, Y.-C. J., Brandli, L. L., Avila, L. V., Azeiteiro, U. M., Caeiro, S., & Madruga, L. R. d. R. G. (2017). Identifying and overcoming obstacles to the implementation of sustainable development at universities. *Journal of Integrative Environmental Sciences*, *14*(1), 93-108. https://doi.org/10.1080/1943815X.2017.1362007

Mistry, A. (2020). *Research excellent framework impact case study 2014 SDG keywords*. University of Leicester. Retrieved 01.11.2023 from https://leicester.figshare.com/articles/dataset/Research_Excellent_Framework_Impact_Case_Study_2014_SDG_keywords/12839444/1

Moallemi, E. A., Malekpour, S., Hadjikakou, M., Raven, R., Szetey, K., Ningrum, D., … Bryan, B. A. (2020). Achieving the sustainable development goals requires transdisciplinary innovation at the local scale. *One Earth*, *3*(3), 300-313. https://doi.org/10.1016/j.oneear.2020.08.006

Monteiro, N. B. R., da Silva, E. A., & Neto, J. M. M. (2019). Sustainable development goals in mining. *Journal of Cleaner Production*, *228*, 509-520. https://doi.org/10.1016/j.jclepro.2019.04.332

Okubo, K., Yu, J., Osanai, S., & Serrona, K. R. B. (2021). Present issues and efforts to integrate sustainable development goals in a local senior high school in Japan: A case study. *Journal of Urban Management*.

Osman, A., Ladhani, S., Findlater, E., & McKay, V. (2017). *Curriculum framework for the sustainable development goals*. Commonwealth Secretariat. Retrieved 24.09. 2023 from https://www.thecommonwealth-educationhub.net/wp-content/uploads/2017/01/Curriculum_Framework_for_SDGs_July_2017.pdf

Rauch, F., & Steiner, R. (2013). Competences for education for sustainable development in teacher education. *CEPS journal*, *3*(1), 9-24. https://doi.org/10.25656/01:7663

Rieckmann, M. (2017). *Education for sustainable development goals: Learning objectives (UNESCO 2017)*. Unesco Publishing. https://doi.org/10.54675/CGBA9153

Scoones, I., Stirling, A., Abrol, D., Atela, J., Charli-Joseph, L., Eakin, H., … Priya, R. (2020). Transformations to sustainability: combining structural, systemic and enabling approaches. *Current Opinion in Environmental Sustainability*, *42*, 65-75. https://doi.org/10.1016/j.cosust.2019.12.004

Shubankar, K., Singh, A., & Pudi, V. (2011). A frequent keyword-set based algorithm for topic modeling and clustering of research papers. 2011 3rd Conference on Data Mining and Optimization (DMO),

Sinclair, J. M. (2004). *Trust the Text*. The Search for Units of Meaning. 24-48. Taylor & Francis Group. USA and Canada.

Singh, D., & Singh, B. (2020). Investigating the impact of data normalization on classification performance. *Applied Soft Computing*, *97*, 105524. https://doi.org/10.1016/j.asoc.2019.105524

Uddin, S., & Khan, A. (2016). The impact of author-selected keywords on citation counts. *Journal of Informetrics*, *10*(4), 1166-1177. https://doi.org/10.1016/j.joi.2016.10.004

UN. (2015). *Transforming our world: the 2030 agenda for sustainable development. United Nations, New York*. Retrieved 02.11.2023 from https://sdgs.un.org/sites/default/files/publications/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

UN. (2020). *Sustainable Development Goals Guidelines for the Use of the SDG Logo Including the Colour Wheel, and 17 Icons.* Retrieved 25 March 2021 from https://www.un.org/sustainabledevelopment/wp-content/uploads/2019/01/SDG_Guidelines_AUG_2019_Final.pdf

UNESCO. (2014). *Sustainable development begins with education: How education can contribute to the proposed post-2015 goals*. Retrieved 24.09. 2023 from https://unesdoc.unesco.org/ark:/48223/pf0000230508

UNESCO. (2017). Education for Sustainable Development Goals. The Global Education 2030 Agenda. In: UNESCO Paris, France.

UoA. (2021). *The University of Auckland SDG Keywords Mapping*. The University of Auckland. Retrieved 02.11.2023 from https://www.sdgmapping.auckland.ac.nz/files/2020/10/UoA-SDG-Keyword-List-Ver.-1.1.xlsx

Verhulst, E., & Lambrechts, W. (2015). Fostering the incorporation of sustainable development in higher education. Lessons learned from a change management perspective. *Journal of Cleaner Production*, *106*, 189-204. https://doi.org/10.1016/j.jclepro.2014.09.049

Voulvoulis, N., & Burgman, M. A. (2019). The contrasting roles of science and technology in environmental challenges. *Critical Reviews in Environmental Science and Technology*, *49*(12), 1079-1106. https://doi.org/10.1080/10643389.2019.1565519

Weismayer, C., & Pezenka, I. (2017). Identifying emerging research fields: a longitudinal latent semantic keyword analysis. *Scientometrics*, *113*(3), 1757-1785. https://doi.org/10.1007/s11192-017-2555-z

Whittingham, K. L., Earle, A. G., Leyva-de la Hiz, D. I., & Argiolas, A. (2022). The impact of the United Nations sustainable development goals on corporate sustainability reporting. *BRQ Business Research Quarterly*, 26(1), 45-61. https://doi.org/10.1177/234094442210855