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# Meta-Analysis: Impact of Sustainable Development on Pedagogical Approaches in Education

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## Abstract

Sustainable development in education system can lead towards an innovative and productive world. In this study, meta-analytical approach is used to provide key themes of education for sustainable development (ESD), its basic competencies, and pedagogies. The main agenda of ESD is to achieve the goals of sustainable development (SD) by 2030. This review article focuses on an educational perspective that strengthens the educational institutions and empowers all the stakeholders. The current study shows the practices of last ten years to manifest that sustainable development is a significant tool in education. The primary focus of SD is to ensure advancement in the field of skill development. By following this process, teaching becomes constructive and meaningful. In this study, the meta-analysis research method is followed, reporting the analysis of more than sixty (60) research articles. The results and findings were interpreted through a screening process. The results showed that there is a positive and significant effect of sustainable development in the domain of education. Therefore, ESD competencies and pedagogies validate the performance of teachers, students, and all the stakeholders who desire to attain expertise in their respective practices.

***Keywords*:** education for sustainable development (ESD), pedagogies for ESD, SDGs (sustainable development goals)

## Introduction

In the words of John Dewey, "education is the continuous reconstruction of experiences". He argued that the process of learning could be understood in terms of a teacher's crucial role in facilitating the learners (Colgoni & Eyles, 2010). In the learning process, the student's participation is the basic objective through which they act as a participant to integrate their own perceptions (Keiler, 2018). Socrates and Plato are of the opinion that, the acquisition of knowledge is the goal of education because knowledge is the

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complete virtue. Knowledge has two dimensions that are the interest of a person and that of a society (Murphy, 2015).

Education provides the basis for the process of learning and knowing that makes an individual a responsible citizen and a constructive human being (Eilks, 2015). This level of education is not only confined to schools, instead this learning environment comes through the surroundings that an individual has faced or lived in. The starting point of gaining knowledge is known as the mother's lap. Then institutions, peers, and teachers promote the formal and informal learning (Eilks, 2015; Findler et al., 2019).

In the contemporary global context, education revolves around the scientific process (Nazar et al., 2018). Therefore, science education is the progressive and emerging stream that based upon the factual knowledge. If one does not take assistance from the scientific processing then it becomes pointless (Sanchez-Carracedo et al., 2021). In the modern era, there is a practical shift from the fact based knowledge that provisioned the skills, altitudes, and values together with the understanding (Jessani, 2015).

There is a new gateway of 21st century skills that ensures the quality of education under the program of science education (Colgoni & Eyles, 2010). It is not simply a read and write practice however, it prepares one's self to cope with the modern world in the field of science and technology. In 2018, Nazar et al. mentioned that the transformational shift requires oriented skills such as teamwork, problem-solving, and many others that have the power to replace and alter the existing skills. This transition in the order of economy requires more new skills with modern workplace and staff who can solve (non-routine problems) and make appropriate fluencies to perform social skills having complexity (Karaarslan & Teksoz, 2016).

The new set of skills demands unique characteristics that are required for the effective evolution of students' futures (Erdem et al., 2019). These characteristics include creativity, critical thinking, and problem-solving thus, providing us with high literacy rate (Sarican & Akgunduz, 2018). There is advancement in the field of education as the transitional changes occur. The change was seen in 21st century because the era focuses on skill development learning of the students instead of rote memorization. The skill-oriented programs are thought provoking programs that make the learner independent to others and responsive for their actions. This objective has excluded in rote memorization and it is also a basic difference

between skill-based and memorization-based programs (Nessipbayeva, 2012).

Trilling and Fadel (2012) suggested three schemes considering the 21st century skills categorizes as learning and innovative skills, digital literacy, career life skills. The most influential factor that connects these schemes and synchronizes all the disciplines into one stream is known as sustainable development. The sustainable development is the process of change under the influence of resources for instance the mode of investment and economy, technological development and modifications among institutions. According to Brundtland report, betterment occurs in present and future potentials to meet the needs of living beings and their aspirations as well (Goodland, 1991).

**Sustainable Development**

The concerns of disturbance in natural systems with social challenges are dealt by sustainable development. Sustainable development has many definitions in the literature that meet the criteria of present situation of exploitation of resources (Boeve-de Pauw et al., 2015). It is defined as the development in a sustainable manner without compromising the resources of future generation to fulfill the needs of present age. It is considered as a suitable pattern that makes a grant for those living in future to be able to use the resources, such as food, clothing, and shelter necessary to survive in the living world (Chinedu et al., 2018). According to Brundtland commission of United Nations, the word sustainable has its own meanings that are beneficial and contextual. Contextual meanings are significant as they define the factor of sustainable development that it does not allow the overuse of resources (Brundtland, 1985).

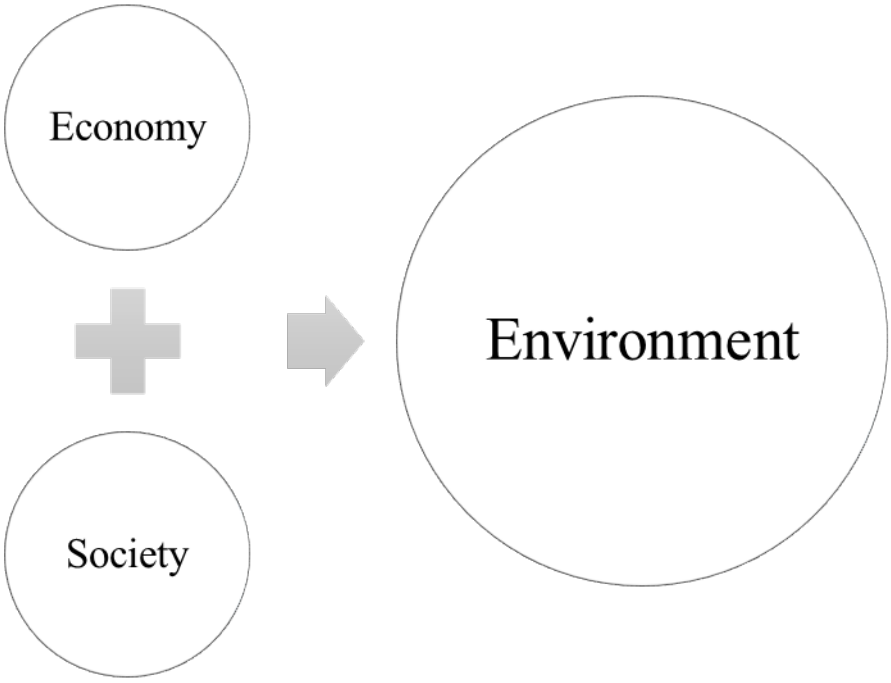
The framework of sustainable development visualizes three aspects including economy, society, and environment (Khan et al., 2013). These aspects are overlapping pillars of sustainable development embedded. In a way that economy is immersed in the society and society is immersed in the environment. It is noted that environment is the critical aspect playing a powerful role between other these two aspects of economy and society (Winkler & Williams, 2017).

Figure 1 represents that society depends upon economy. If the economic growth is beneficial then society becomes a supportive element for every

person. These two integrated factors depend upon the environment (Laurie et al., 2016; Hoffmann & Siege, 2018).

**Figure 1**

*Three Aspects of Sustainable Development*




## Sustainable Development Goals

The goals of SD (sustainable development) are approved by the general assembly of United Nations Resolutions with the duration of 2015-2030. These goals depend upon the agenda of Millenium Development Goals (MDGs), having a time-line of five years from 2000 to 2015 with larger scale and scope. These previous agendas connect the present and future scenarios in a sustainable way for achieving the global progress by linking people and their planet. Then in 2015, SDGs were monitored at the general assembly of UN (Government of Pakistan, 2019).

To highlight the sustainable development goals, the meeting of all stakeholders ensured through a universal call was organized in order to achieve future sustainability by 2030. Among these stakeholders included state heads, representatives of UN-high level, leaders at governmental level, and also all the members of civil society. This agenda, achievable by 2030,

consists of seventeen goals (17 SDGs) that act as the driving force for the sustainable development (Chasek et al., 2016). The nature of 17 SDGs is inter and multi-disciplinary.

These are "zero hunger, no poverty, good health and well-being, quality education, gender equality, clean water and sanitation, affordable and clean energy, decent work and economic growth, industry, innovation and infrastructure, reduced inequalities, sustainable cities and communities, responsible consumption and production, climate action, life below water, life on land, peace, and justice strong institutions, and partnerships for the goals. These goals work coherently as sustainability working to reinforce in achieving high success in the future (Withisuphakorn et al., 2019).

The same consensus is designed by all the provinces of Pakistan within the framework of national development (Government of Pakistan, 2019). This step ensures the sustainability level or progress at national level and also provides the guidance that how to achieve these SDGs by 2030 through the commitment of "Leave no one behind" (Eilks, 2015).

**Sustainable Development Goal-4**

The seventeen goals of SD are different from each other in their context and meanings. The focus of this research study is to examine the SDG-4, that is, "quality education". The leading concern of this goal is to ensure the improvement within life through sustainable manner for the future aspects and understandings. It is due to this influential goal that the quality of education is made better without discrimination among all levels of education (Karatzoglou, 2013).

The significance of this goal is to associate and integrate education with the life-long learning providing unique opportunities to all, and empowering the needs as well. The quality education is for all ages and not for particular ages only, because it deals with equality upon equality. It demands the high-level understanding about education in the local context but understands the variability in the global context also (Karaarslan & Teksoz, 2016). The SDG-4 varies according to the need and situations depending upon the nature of quality education (Winkler & Williams, 2017).

**Education for Sustainable Development**

The goals of SD address those societal issues that humans are suffering from such as, growth of economy and principals of justice in social context.

Similarly, some aspects of these goals are interpreted in the science education. Science education is the influential domain that productively produces professional teachers in a strategic way. The domain is termed as education for sustainable development when it is a combination of teaching, learning, sustainable development, and community progress (Burmeister et al, 2012).

The reflective teaching was practiced through the catalytic approach by teachers who intended the meanings of ESD. The approach supports developmental participation towards the betterment of society. The aim of ESD is to accomplish the link in all aspects of life that are inherited and integrated. Through this aim, there is a significant improvement among all the levels of learning and knowing (Nevin, 2008; Mensah, 2019).

Goal-4 supports the process of education as a complete set of conception supporting the sustainable development. ESD also supports those competencies by which every person becomes a responsible citizen (Hassan, 2021). ESD develops the ability of decision making process among people and it is the basic aim of this agenda. Therefore, they can perform their actions and responsibilities in a better way thus, transforming the quality of life.

The competencies of an individual are measured and strengthened by the teachings of ESD. In this way, individuals can easily participate in the agenda of sustainable development process (2015-2030) allowing them to contribute in various dimensions. The basic competencies include reading, writing, and numeracy (O'Flaherty & Liddy, 2018). On the basis of sustainable teachings of the modern era, the new competencies and skills emerged along with these basic competencies. These include thinking competency, normative competency, strategic competency, collaboration competency, critical thinking, and integrated problem-solving competency, and self-awareness competency along with other competencies in education for SD (Paris & Alim, 2017). These competencies were also practiced in higher educational system (Navarro-Espinosa et al., 2021).

## Pedagogical Approaches

Teaching is an art providing instructions depending upon the situation, time and learning needs of the learners. Teachers used different teaching techniques to upgrade their classroom environment. The learning environment should be effective for both the students and teachers

constructively to achieve the targets such as educational goals with pedagogical skills. These approaches show variation according to the diversified culture that allows them to grow in an effective way. In the learning process, these approaches help the learner to enhance both their skills and cognitive abilities. However, these pedagogies are not in use to convey the concept of sustainability and the content about sustainable development (Lozano et al, 2017).

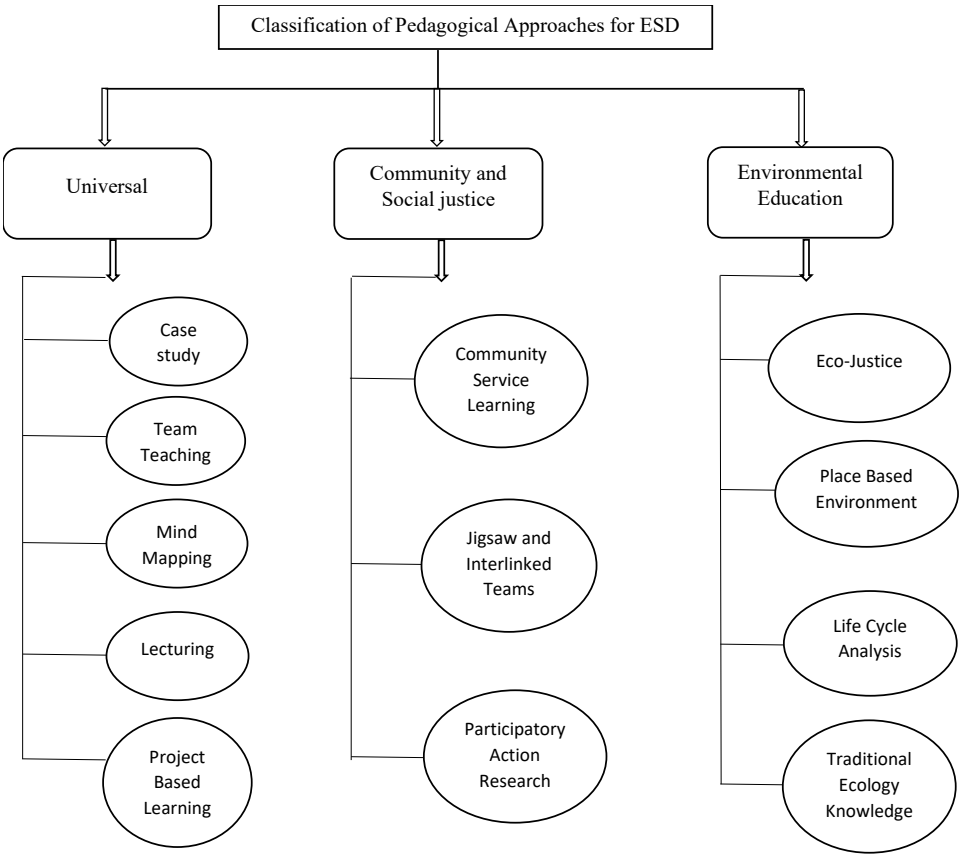
The multi-method approach will be appreciated for the quality education under the framework UN decided for ESD. The different combinations of pedagogical approaches with multi methods requirements make reflective practices in teaching and learning process. These methods motivate the students to think critically which is a challenging demand of the global world. This aim transforms the teaching and learning world towards alternative techniques in the field of education along with the goals of SD (Obi & Obiadazie, 2014).

There are many different pedagogical approaches reported in literature regarding ESD and these are used for the learning process of this domain. These pedagogies demonstrate the potential to improve the educational strategies. There is also a philosophical concept present in the process of SD to instruct the following pedagogies. The strategic activities such as concept mapping also known as mind mapping and road mapping are prominent features of the ESD agenda. In literature, the researchers state three main streams and approaches of the ESD pedagogies (Martin-Garin et al., 2021). These are:

1. *Universal pedagogies* are used in almost all categories and discipline. It includes team teaching, mind mapping, and problem-based learning (problem-solving learning). Further, it includes case studies and project-based learning to enhance the capacity of the learners.
2. The pedagogy related to *community and social justice* addresses the content of social justice, and service learning of community that comes under the domain of community building.
3. Lastly, the domain of pedagogy is related to *environmental education* that specifically illustrates the environmental sciences and practices based upon the environment such as knowledge of traditional ecology and analysis about life cycle.

**Figure 2**

*Pedagogical Approaches of ESD*




Following are the synthesis of ESD pedagogical approaches used in teaching and learning process (Bascope et al., 2019; Carlos, 2019; Martin-Garin et al., 2021; Missimer & Connell, 2012; Park et al., 2022).

## Universals

### *Case Study*

Case studies are the pedagogical approach of qualitative data that describe the problems in sustainable development faced by students through the system of interaction. Case studies allow the students to interact with the examples of real world and then solve these problems and issues in the

perspective of ESD. Through this activity, students get the opportunities to engage themselves in the activity of the research. This is a complex process of integration between the society and related environment.

### *Inter-disciplinary (Team Teaching)*

The inter-disciplinary and trans-disciplinary courses promote the critical thinking among students. Their analytical thinking ability makes them prepared for the probability of having an authority to deal with different problems. Teachers faced the issues and difficulties to bring in harmony the course content and practices, while finding new directions and guidance in group processes.

### *Lecturing*

The lecture is a structured plan and it is effective introduce the material related to the specific subjects and concepts. The prepared lectures are usually based on the skilled competency that consists of nobility and uniqueness as well as the effectiveness of content for the learners. The professional teachers with profound subject information play the significant role in demonstrating the deep understanding of the subject knowledge. Lecture method proves the mastery towards a standard approach and that mastery is set up by the instructor with the combination of their expertise and motivational strategies. The professional instructors are expected to express the norms, ethics, and values under the domain of ESD. This approach becomes effective for students' learning ensure the quality education with sustainable development.

### *Mind Maps and Concept Maps*

Mind maps are considered as mental guidelines addressing the connection between thoughts graphically. This is a widely used approach when we deal with the concept of ESD. The framework of mind map and concept map signifies the idea and topic with key thoughts. They are also known as the emergence of cognitive abilities that are truly involved in this pedagogical approach. These mind maps also incorporate short expressions or pictures that impart different connections. These connections are verifiable and involve the utilization of various educational methodologies as a tool thus, provide the adequacy in the field of ESD. The result of this approach demonstrates the better understanding of sustainability in a course with constructive learning and also it is community-oriented approach.

### *Project-based Learning*

The project-based learning approach gives the opportunity to learner as a complex phenomenon to experience the practical worksite. This learning comprehensively covers the way to deal with complexity and real-world problems, developing knowledge, attitude and behavior of ESD. Students are working as independent cooperative groups and engage themselves in peer collaboration.

## Community and Social Justice

### *Community Service Learning*

Learning based on community services is making learners adaptable to take part in those exercises that are beneficial for others. These practices are associated with learning platforms that are designed purposefully in an integrated manner. This becomes valuable for all the local area organizations and educational institutions. The community-based activities are social activities which include public libraries, different foundations working on the motive of social justice, and empowerment. This learning strategy provides the practice-based training to recycle the resources for public dealings. In community service learning there is a potential that change learners' perspective, thus creating innovative worldviews. In this aspect, learning adds enhancements in students' reactions to vulnerability, reflexivity in their own learning, and the level of consciousness related to those problems that comes under the stream of society.

### *Jigsaw or Interlinked Teams*

This learning model promotes the peer learning using cooperative learning techniques. The main goal is to assist and foster the attitudes of students towards ESD. The students are appointed to foster aptitude on various sub-themes and are divided into groups. Students with aptitude in each sub-theme are gathered to make a new 'jigsaw' learning group. In the jigsaw group, every student will be the master and is relied upon to instruct that theme to their jigsaw colleagues and gain different subjects from these jigsaw partners to build a total image of the whole point.

A more extensive interlinked group approach is that, each student is assigned into two small groups having equal tasks or examination subjects. The student after creating mastery in each group is then imparted into the next group. The standard jigsaw way to deal with cooperative

learning worked on students' certainty, interest, emotional commitment, and self-reports in physical science, while yielding distinction in test achievements. It is observed that the students can perform better in their specialized field of study then those areas in which they are depended on peer guidance as in conventional educational circumstances.

### *Participatory Action Research*

Participatory action research is the learning activity based on the philosophical methodology. The cyclic and reflexive nature however, underlines the cooperative idea of the examination and the development of information by all members. The participation of students through activity of action research can be a strong strategy for improving students' determination in advanced or higher education.

## Environmental Education

### *Eco-justice and Community*

An effective transformation has been done through the eco-justice and community learning that is the part of pedagogical approach of environmental education. It involves in a profound change with respect to teachers and students mindset. This is the turning point making a shift from robotic (mechanistic) and modern analogies to illustrations that were established in living nature and organic frameworks. This seems to be a philosophical transition for both society and community. The philosophical change fundamentally emphasizes on the diversity, connections, and self-creation that are the characteristics of a complex versatile framework of sustainable development. This pedagogy follows three basic considerations. These are environmental racism and class discrimination, recovery of the non-modified aspects of community, and responsibility to future generations.

### *Place Based Environment*

Place based environmental education can be portrayed as a way to deal with educating and discovering those individuals having experience and information that really focus on surroundings It tries to associate logical agreement and enthusiastic connection with a particular topography being investigated. These learners actively participate in outdoor learning, experiential learning, and bioregional practices.

### *Supply Chain Analysis/ Life Cycle Assessment*

The supply chain analysis is challenging for students in the domain of sustainability and education because it is an activity-based teaching and learning process. The challenges faced by students while considering ESD are economic, social, and environmental backgrounds along with their effects. The life cycle assessment deals with technical and valuable evaluations in the learning of pupils through international practices. Therefore, they seek light from experiences of professionals within a diversity of disciplines and students assess or interpret the data from these sources in the real world and for further implications in the future.

### *Traditional Ecological Knowledge*

The nature of society depends upon the culture that provides the opportunity in the socio-ecological system. Although it is a complex system of knowing that is used as a powerful tool in providing valuable information while sustaining the cultural diversity.

### Research Objectives

The objectives of the current research in terms of education for sustainable development are:

1. To analyze the literature related review on concept of sustainable development considering innovation and productivity over the past ten years.
2. To identify the literature related review on aspects of sustainable development in terms of education over the past ten years.
3. To explore the literature related review on pedagogies influencing education for sustainable development in teaching and learning process over the past ten years.

## Material and Methodology

This section includes methodology and procedures upon which the research study has been carried out. The focus of this research is on education for sustainable development in which SDGs play a significant role with pedagogical practices to ensure the quality of education. For this purpose, different authentic sources have been approached for the collection of data. These include data basis and digital library, that is, Z-library and research articles and work that are accessible on Google Scholar, Springer, ERIC,

and Research gate. On the basis of inclusion criteria, the screening of the data for the research study proceeds in two ways. These include the in-depth review of the related literature, while the analytical and comparative analysis of articles was done based on the core components that are objectives, research questions, sampling or instrumentations, data collection procedure, data analysis, and findings.

Meta-analysis relates the combination of various results and screens the particular findings and results. The overall result may be either significant or insignificant, but it is undoubtedly more accurate and more credible because of the overarching span of such an analysis. Meta-analysis is considered as the form of evidence-based practice. Evidence based practice (EBP) is the process of integrating the best evidentiary information available to expertise (Sackett et al., 2006). Meta-analysis was a term described by Gene Glass in 1976 and described it as an "analysis of an analysis".

Meta-analysis approach is used to explore the nature of education within the stream of sustainable development. A meta-analysis approach is the distinctive approach that aggregates the data by reducing inappropriate data sets. It is the significant analysis providing the detailed review of the research study that operationalizes all significant variables of the study (Abedijafari & Amiri, 2019).

This is an explanatory and systematic research study with a vision to investigate the connection between education and sustainable development. The study nature is qualitative, while assessing different pedagogies that promote ESD because there is no use of any statistical analysis to present the findings and results. In the given scenario, the research study deals with the unbalanced happening between society and natural resources. This imbalanced situation becomes a major threat in the process of sustainable development. Because the goal is to achieve the criteria that is, "there is no compromise on resources to meet the present needs and exploit the future generations" (Barth & Michelsen, 2013).

## Results and Discussion

The literature screening illustrates that education for sustainable development in all aspects is a modernize concept and gives positive strength to the educational institutions and stakeholders. Sustainable development largely focuses on people, their well-being, and equity in their

relationships in a context where nature and society imbalances and can threaten sustainability. The ESD practice promotes innovation and productivity among individuals and promotes implementation of decision-making skills (Kolleck, 2019). However, educators lack expertise in this domain to fulfill the criteria of implementing the concept of ESD as individuals are found to have low behavioral tendency towards this natural practice (Prabawani et al., 2020; Redondo & Ladage, 2023). Therefore, education for sustainable development is the main agenda that effectively contributes in innovation by technology integration.

All citizens must involve in the practice of ESD with skills and knowledge that will help in solving the present problems and prepare for future challenges. Education is the key to achieve SDGs as it will play an important role in producing the human resources in a sustainable manner. Similarly, Ilisko and Badyanova (2014) argued that sustainability act as a catalyst in the transformation of the education. Organized sustainable schools serve as sites for delivering a rich learning environment that fulfills the requirements of every student by giving them the chance to engage for meaningful learning outcomes. As per literature screening, results depict that aspects of sustainable development include social, economic, and environmental aspects. These aspects are the baseline in the field of progress and promote sustainable education in the society.

ESD pedagogies encourage the acquisition of knowledge, attitudes, and abilities that are needed to build sustainable communities. In order to expand ESD beyond national boundaries, the research also revealed the necessity of integrating ESD throughout all subject areas, while offering professional development to educators who are adopting ESD management methods to support ESD in the curriculum (Laurie et al., 2016). Various ESD pedagogies are in practice by educators as a result of literature screening. These include three main categories, namely universal pedagogies, community and social pedagogies, and lastly environmental education pedagogies. These ESD teaching strategies encourage learners to think critically, analyze, pose questions, and reach towards viable solution. These pedagogies shift the focus of teachings from the teacher to the student and from rote memorizing to interactive learning.

ESD is the universally accepted terminology and have relation to the need to renegotiate the human-nature relationship. It is now considered as the core value among all fields of life, thus not only related to education.

Education is the basic and initiative step to influence this terminology in a positive way (Hoffmann & Siege, 2018). This makes one of the masters' concepts of 21st century. The mitigated measures are being influenced by sustainable development (Colgoni & Eyles, 2010). It is crucial to work in emergency situations, while keeping the focus on the long-term benefits, building sustainable development, and using the 2030 agenda as a road map. Such as a variety of mitigation measures are being put in place through great efforts and a great cost in order to address the impact of COVID-19 and reduce the risks of future crises, especially for the poorest and most vulnerable people and countries (Abubakar et al., 2021; Leal Filho et al., 2022).

## Conclusion

It is concluded that sustainable development is the productive paradigm that emerged in the 21st century. There are three aspects of sustainable development that supports education in a sustainable manner. These aspects include economy, society, and environment that collectively play an integrated role globally. These aspects have significant impact on education that contribute in creating the collaborative world. In this discipline, different types of pedagogies are used to teach the learners with the scheme of sustainability. The sustainable pedagogies build the decision making ability among teachers and students. Therefore, it is important to empower the individuals in the field of sustainable development. To conclude the study, education is both an essential part of sustainable development and a driving force behind it. Further, societies can promote a sustainable culture, equip the next generation to tackle global issues, and create a more just and resilient society by investing in education for sustainable development. ESD is now a universal term and used to renegotiate the human-nature relationship. It is considered as the central core to all fields of life, not only those related to education, but also in other subjects. Thus, ESD is the influential terminology that makes one of the master concepts of the 21st century.

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