Taxonomy of Educational Objectives: Teaching, Learning, and Assessing in the Information and Artificial Intelligence Era

Mohammad Awad AlAfnan[1,*]

[1]Liberal Arts Department, American University of the Middle East, Kuwait

*Correspondence: American University of the Middle East, Kuwait. E-mail: Mohammad.Al-Afnan@aum.edu.kw

Received: June 5, 2024 Accepted: August 1, 2024 Online Published: August 7, 2024

doi:10.5430/jct.v13n4p173 URL: https://doi.org/10.5430/jct.v13n4p173

Abstract

This study reviews existing taxonomies and proposes a new educational taxonomy that fulfills the educational needs of the current era, the information and Artificial Intelligence (AI) era. The review of previous educational taxonomies revealed that although they provide insights into establishing educational objectives and learning outcomes, they still need to address recent changes and challenges in learning processes. To (1) integrate the new realities into the landscape of learning (i.e., Education for sustainable development (ESD), soft skills development, and AI), (2) maintain the classroom as the formal venue for learning, and (3) strengthen the position and role of instructors as facilitators, a new six-category two-fold hierarchy-based taxonomy is proposed (AlAfnan Taxonomy): (1) Knowledge and Comprehension, (2) Synthesis and Evaluation, (3) Ethical and Moral Reasoning, (4) Application and Strategic Thinking, (5) Creativity and Innovation, and (6) Lifelong Learning and Adaptability. The taxonomy begins with foundational levels of 'Knowledge and Comprehension' stressing the importance of understanding fundamental realities and concepts within specific fields. Then, it addresses the importance of 'Synthesis and Evaluation' as essential and crucial skills for navigating an information-rich world. 'Ethical and Moral Reasoning' highlights the significance of ethical decision-making, moral frameworks, and culture-based diversity. Further, the taxonomy introduces 'Application and Strategic Thinking', emphasizing the practical use of knowledge in real-world scenarios and the ability to devise long-term plans. 'Creativity and Innovation' are essential drivers of progress in an era characterized by rapid technological advancements encouraging learners to explore novel solutions and approaches. Lastly, 'Lifelong Learning and Adaptability' underscores the necessity of continuous learning and flexibility in response to evolving circumstances, ensuring students and graduates remain competitive and relevant throughout their lives. By nurturing a multifaceted skill set encompassing critical thinking, ethical awareness, practical application, creativity, and adaptability, this taxonomy aims to equip learners with the necessary tools to excel in a dynamic and complex world, making it indispensable for modern education.

Keywords: taxonomy, teaching, learning, educational objectives, learning outcomes, assessments

1. Introduction

Setting educational goals and achieving them, in terms of learning and assessment, have always been the struggle of educators throughout the years. To overcome this struggle, specialists in curriculum design and other domains have created various teaching and learning frameworks, taxonomies, and models. Scholars came up with frameworks and taxonomies to improve student's learning experience, on the one hand, and enhance the process of assessments, on the other hand (i.e., Bloom, Engelhart, Furst, Hill, and Krathwohl, 1956; Dave, 1970; Simpson, 1972; Krathwohl et al., 1964; Biggs & Collis, 1982; Anderson & Krathwohl, 2001; Fink, 2003). These scholars developed cognitive, affective, or psychomotor frameworks used as guidelines or conceptual frameworks in schools, colleges, and universities to create or modify new courses. These learning taxonomies or categories are frequently used to describe the many learning behaviors and traits instructors want students to acquire. They are often used to distinguish between different phases of learning progression; therefore, they are valuable tools for determining whether particular learning outcomes are appropriate for specific module levels within courses.

The taxonomies usually included three domains: cognitive, affective, and psychomotor. They view learning as a process that develops learners' abilities to achieve pre-established learning outcomes. For example, Bloom et al. (1956) developed six primary levels: knowledge, comprehension, application, analysis, synthesis, and evaluation. In

2001, Anderson and Krathwohl (2001) updated this taxonomy. In the revised version, they strongly emphasized restructuring the educational objectives hierarchy presented in the original framework and adding a new domain (psychomotor). They used action verbs to replace the nouns to name the seven cognitive categories they named: remember, understand, apply, analyze, evaluate, and create. The first category in Bloom et al.'s (1956) taxonomy was extended to include four cognitive knowledge categories: factual knowledge, conceptual knowledge, procedural knowledge, and metacognitive knowledge. Every single category of knowledge is also divided into several sub-knowledge categories.

Since their introduction, Bloom's taxonomy (the original and the revised (Bloom et al., 1956; Anderson & Krathwohl, 2001)) has received much attention. From an instructor's perspective, instructors can use them to determine the intellectual capacity of each student and set clear objectives for their development. Additionally, they can offer a framework for cognitive operations that can be used to evaluate activities, understand how difficult they are, and simplify or complicate these activities accordingly. These two taxonomies also help academics refine their learning objectives and outcomes. From the students' perspective, Bloom's original and revised taxonomies (Bloom et al., 1956; Anderson & Krathwohl, 2001) help students develop higher-order thinking capabilities by honing their lower-level cognitive abilities. They also aid students in acquiring skills that include creativity. They aid in students' psychological development. From a university and college perspective, Bloom's original and revised taxonomies (Bloom et al., 1956; Anderson & Krathwohl, 2001) assist in setting realistic learning outcomes that can be tracked and achieved. However, with the new realities in the learning landscape (i.e., Education for Sustainable Development (ESD), soft skills development, and AI), we need an updated taxonomy that caters to the current and future learning needs.

There is a growing emphasis in education on soft skill development and Education for Sustainable Development (ESD). Along with developing social, emotional, and behavioral skills (AlAfnan & Dishari, 2024; Almeida & Morais, 2021), students are expected to build competence in sustainability, which leads to developing knowledge, skills, attitudes, and values necessary to shape a sustainable future (UNESCO, 2014). Students, as such, are expected to acquire more than just the hard skills related to their majors. They are also likely to develop transversal skills (AlAfnan & Dishari, 2024a) that would allow them to succeed in this ever-changing world. In addition, recent developments in Artificial Intelligence (AI) have paved the way for APPs, platforms, and Chabot that can 'create' content in any form based on provided prompts, images, videos, schedules, or raw material. AI platforms these days can assist in analyzing data, evaluating and improving texts, generating research papers, generating reports, taking notes, managing inboxes, and solving mathematical problems (Abrahamson & Sánchez-García, 2016; AlAfnan & Dishari, 2024b). As such, AI platforms have semi-human abilities to apply, analyze, evaluate, and create. They also can 'remember' by describing, listing, reciting, identifying, labeling, naming, and repeating. They also 'comprehend' examining, grouping, generalizing, sorting, paraphrasing, and rephrasing. Per se, the educational objectives in institutions are challenged. If they continue being the same, academic institutions will be obsolete as students have access to all they need without the need to attend classes.

With all these points in mind, a new taxonomy is needed to cater to all these needs. A taxonomy of educational objectives that (1) integrates the new realities in the field of learning, (2) maintains the position of classrooms as the formal venue for learning, and (3) strengthens the position of teachers as facilitators.

2. Educational Taxonomies and Frameworks-Literature

Over the years, scholars have proposed taxonomies and frameworks of educational objectives (i.e., Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956; Dave, 1970; Simpson, 1972; Krathwohl et al., 1964; Biggs & Collis, 1982; Anderson & Krathwohl, 2001; Fink, 2003) to assist developing students' abilities to learn and instructors' abilities to assess and evaluate.

In 1956, Bloom and several of his colleagues at the University of Chicago proposed a framework for learning objectives (Bloom et al., 1956). This framework is commonly known as Bloom's taxonomy. The taxonomy has a hierarchical framework that groups learning objectives into several categories based on complexity. It starts with lower-level thinking skills and to higher-level thinking skills. The taxonomy was created to promote more sophisticated thinking techniques in classrooms. Bloom et al.'s (1956) taxonomy emphasizes examining concepts, methods, processes, and principles rather than merely memorizing information. Bloom et al. (1956) listed six cognitive levels. Knowledge is the acquisition of facts, figures, and essential principles. Comprehension is about making sense of this knowledge by creating understanding. Application is the process of using ideas and information in practical situations. Analysis is assessing an application, coming to conclusions, and understanding the

relationships between its many parts. Synthesis is the combination of information in different ways, proposing various solutions. Evaluation is the level at which students judge ideas (see Figure 1). All these six levels come under the cognitive domain in Bloom et al. (1956) taxonomy.

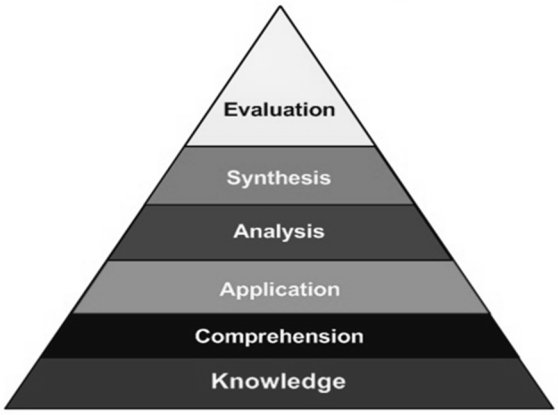

Figure 1. Bloom's Taxonomy (Bloom et al., 1956)

The affection domain included elements that help learners feel and understand the happiness and suffering of others. It features complex personalities, concepts, and phenomena. The development of attitudes, emotions, and feelings are frequently at the center of affective objectives. Bloom et al. (1956) listed five affective domains: **Reception** is the lowest stage when the learner only watches without participating. With this level, learning is possible. In **response,** learners actively participate in the learning process by attending to and responding in some way to the stimuli. At this point, students are inspired and ready to act. In **values**, students assign a particular phenomenon or information value. The learner links the knowledge they have acquired to a value or collection of values. In **organization**, by comparing, connecting, and building on what they have learned, learners may integrate multiple ideas, facts, and concepts and fit them into their mental model. At the characterization stage, learners seek to acquire abstract information, fully absorb their ideals, and behave according to them.

The psychomotor domain is specific to physiological functions, reflex actions, and physical motions used to interpret and learn information. It suggests that exercising encourages or facilitates the development of knowledge and skills. The learner works out to achieve a cognitive or emotive objective. Bloom et al. (1956) listed five levels: Imitation is when learners imitate and duplicate what is being done and replicate it to the degree that is appropriate for this level. Manipulation is achieved as learners replicate instruction and imitate an action. Precision is achieved as learners employ abilities independently. Articulation is achieved when learners adapt their knowledge to finish a challenging assignment. Naturalization is achieved as learners automatically grasp new skills. These three categories (knowledge-based, emotion-based, and action-based categories) are widely used in educational settings today despite several criticisms. Institutions utilize them to improve their teaching methods, tests, and curriculum.

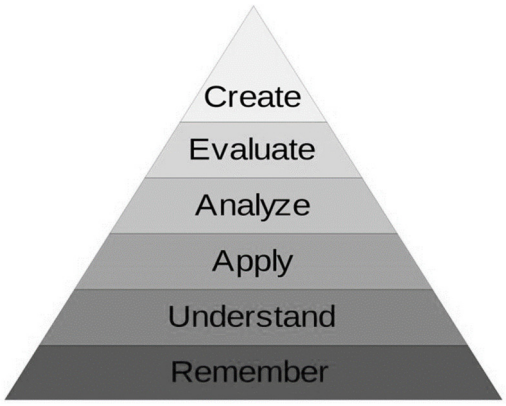

Figure 2. Bloom's Revised Taxonomy (Anderson & Krathwohl, 2001)

Krathwohl & Anderson (2001) revised Bloom's et al. (1956) taxonomy. It became apparent that most instructors use the updated taxonomy when discussing Bloom's taxonomy. One of the most noticeable changes was the placement of 'creating' at the top of the pyramid. According to Bloom et al. (1956), the original taxonomy had the highest level of cognition being 'evaluation,' with 'synthesis' just behind it. To reflect advancements in teaching and learning development and practice, synthesis was modified to 'creating' and elevated to the top of the cognitive hierarchy (see Figure 2). Anderson and Krathwohl (2001) also added four types of knowledge that are factual knowledge, which is the fundamental component of a field that students must understand or use to solve difficulties; conceptual knowledge, which refers to the relationships between the essential parts of a greater whole that enable them to work as a unit; procedural knowledge, which involves carrying out a task or using a technique of inquiry; and metacognitive knowledge, which refers to knowledge about cognition.

In addition to the taxonomies, Biggs and Collis (1982) proposed the Structure of the Observed Learning Outcome (SOLO) taxonomy. Even though educational institutions in many countries use Bloom et al. (1956) taxonomy (the original and the revised), some other countries, like Australia, prefer the SOLO taxonomy. The SOLO taxonomy has been used to set learning objectives, outcomes, and assessments. SOLO taxonomy allows teachers to classify learning outcomes based on the degree of complexity. Additionally, it enables instructors to assess student work based on quality rather than the proportion of successfully answered questions. Biggs and Collis (1982) proposed five hierarchy-based levels that range from incompetent to expert. Students first learn a single or a small number of task components (unistructural), and then they are taught several components with no relation to one another (multi-structural). After that, students discover how to combine these components into a whole (relational). Finally, students develop an ability to generalize that whole to applications that still need to be taught (extended abstract). SOLO may be used for evaluation and curriculum design according to the targeted level of learning outcomes (see Figure 3).

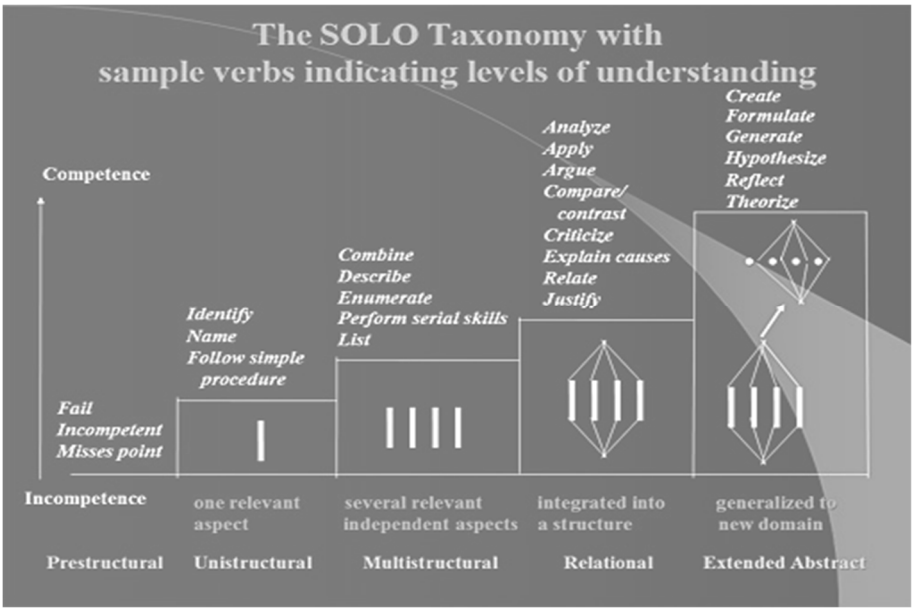

Figure 3. The SOLO Taxonomy with Sample Verbs (Biggs & Collis, 1982)

In addition to the taxonomies above, Fink (2005) developed his taxonomy. According to scholars, Fink's (2003) taxonomy of Significant Learning provides a comprehensive framework for establishing educational objectives. Fink's (2005) taxonomy is non-hierarchical; each element interacts with the other aspects to stimulate different learning (Fink, 2005). Fink (2005) also incorporates components that would fall under Bloom's 'affective' taxonomy, such as 'caring' and 'the human dimension.' Like the updated Bloom's taxonomy, Fink (2005) emphasizes the significance of metacognition as a learning dimension. Fink (2005) developed six foundational knowledge dimensions, which incorporate understanding essential concepts, details, and viewpoints. The application creates critical, inventive, and pragmatic thinking abilities. Integration identifies links between facts, ideas, perspectives, and personal experiences. The human dimension constitutes learning about the self and the other. Caring constitutes acquiring fresh emotions, passions, and ideals. Learning how to learn constitutes lifelong and self-directed learners.

Fink's (2005) taxonomy, according to Dosmar & Nguyen (2021), is highly integrative and views foundational knowledge as an essential component of 'significant learning' in conjunction with the application, integration, the human dimension, caring, and metacognition, or 'learning how to learn,' as opposed to higher levels of learning being described as a sequence built upon foundational knowledge (Fink, 2003). Fink's taxonomy encourages overlap between the many methods of proving knowledge because of its nonlinear nature.

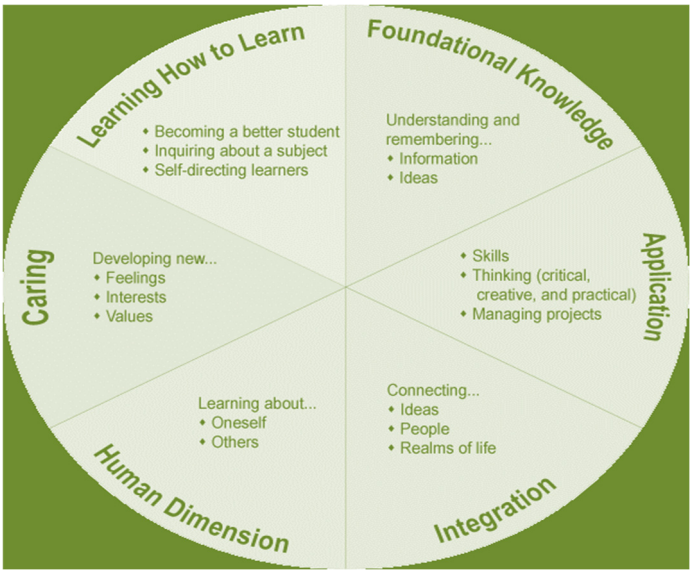

Figure 4. Taxonomy of Significant Learning (Fink, 2005)

In addition to these four taxonomies, some other scholars also presented frameworks for learning. Polya (1957) developed a taxonomy of four categories: understand the problem, plan, do the plan, and Reflect/look back. Webb (1997) also devised a taxonomy of four categories: recall and production, basic application of skill or concept, strategic thinking, and extended thinking. Puentedura (2006) developed the MER taxonomy, including substitution, argumentation, modification, and redefinition. In 2010, Clarkson Bishop and Seah (2010) developed a six-category taxonomy, which includes feeling, responses, expressed reaction, conscious reaction, and organization. Shulman (2010) proposed a six-component category that included engagement and motivation, knowledge and understanding, performance and action, reflection and critique, judgment and design, and commitment and identity. Lastly, DeBellis and Golding (2006) proposed a taxonomy of emotions and feelings. The categories included emotions, attitudes, beliefs, and values.

The taxonomies/frameworks above present different perspectives on learning. Scholars strived to develop these frameworks to assist instructors and educational institutions in developing primary and course learning outcomes. They also needed help to assist instructors in coming up with class learning outcomes, lesson plans, and material to achieve the learning outcomes, on the one hand, and test the achievement of these learning outcomes, on the other hand. In the last 50 years, many educational institutions have adopted these taxonomies as a roadmap to achieve learning. However, with the recent developments in communication technology, artificial intelligence (AI), and large language models (LLMs), we need to develop a new taxonomy/learning framework, as the tools and conveniences our students have these days are unprecedented.

3. Educational Taxonomies and Frameworks-Critiques

As the taxonomies of learning objectives outlined above-received recognition, they were also the source of critique. While Bloom's original and revised taxonomies (Bloom et al., 1956; Anderson & Krathwohl, 2001) have been widely used in education, scholars have raised several critiques over the years. For Krathwohl (2002), Bloom's taxonomy primarily focuses on cognitive skills, neglecting other vital domains like affective and psychomotor skills. Pickard (2007) believes that teaching these days is integrative. As such, having a structured hierarchy does not benefit students. Amer (2006) believes that several new theories and paradigms have been introduced since the introduction of the taxonomy. As such, we need to update the taxonomy to connect to these teaching paradigms and theories. This view is also supported by Startalk (2009). Forehand (2005) contends that Bloom's taxonomy has been

misused to encourage higher-order thinking at the expense of fundamental skills teaching. Marzano (2000) asserts that research does not support the taxonomy's structure, which progresses from the most accessible level of knowledge to the most challenging level of evaluation. According to Soozandehfar and Adeli (2016), the updated taxonomy features ambiguous weightings, cumulative succession, and pedagogical impartiality. Bloom's taxonomy can be used to create questions, but it cannot be used to assess already-existing open-ended questions, according to Biggs and Collis (1982).

While SOLO taxonomy has influenced educational contexts, scholars have raised several critiques. According to Suvin (2023), the challenges and limitations of SOLO taxonomy include subjectivity, surface-level understanding, simplification of complex learning, limited guidance, rigidity in curriculum design, and lack of emphasis on creativity. For Gulzar (2021), the SOLO taxonomy disregards the inherent complexity of the topics. Levels 3 or 4 of the taxonomy are challenging for some topics. At level 5 of the taxonomy (extended abstract level), other subjects could be simple to comprehend, manipulate, and speculate. Therefore, even highly challenging postgraduate-level curricula could include lower-order verbs in their list of learning objectives. Gulzar (2021) also believes that SOLO taxonomy places high importance on assessment and presupposes that courses should consist of learning outcomes. Some instructors could think that evaluations and learning objectives could be more suitable because they discourage innovation and student-led learning. Sprecher (2019) believes that "not all tasks set for students will be of a form that allows the demonstration of the higher levels of SOLO taxonomy" (p. 101). According to Sprecher (2019), multiple-choice quizzes cannot demonstrate the highest level of learning: the extended abstract.

The taxonomy of significant learning is considered a framework designed to enhance the quality and depth of learning experiences. While it has been widely adopted, scholars have raised several critiques. According to scholars, Fink's (2003, 2005) taxonomy is not the best option for novice teachers/instructors. This is the case, as setting goals in Fink's taxonomy is not as straightforward as in Bloom's taxonomy (North Island College, 2023). In addition, even though Fink's taxonomy provides a framework for aligning outcomes with assessments, creating assessments to assess the fifth component is neither simple nor straightforward. It is also believed that novice teachers and instructors might find it difficult to locate online resources to support Fink's framework (North Island College, 2023).

In addition to the critiques presented above, it can also be argued that none of these taxonomies addresses the current and future needs, challenges, and opportunities that are offered by AI and LLMs, on the one hand, and the new realities in the field of education (i.e., education for sustainable development and soft skills competencies), on the other hand. These days, the expectations from teaching and learning are more developed than the traditional expectations in previous years. Teaching and learning these days shall prepare students for global challenges and be AI literate in addition to developing subject-specific literacy. Learning these days is different from teaching and learning before the AI era. These developments have already changed the strategies instructors use, as the traditional methods need to assist in achieving the expected learning goals. If teaching is about providing knowledge, students can acquire the knowledge from open resources. If teaching is about comprehension and understanding, the amount of written, audio, visual, and audiovisual material is enormous. Suppose teaching is about applying, analyzing, evaluating, and creating. In that case, AI APPs can do all of those above in a semi-human manner for free at times or for an affordable subscription. The following section addresses the challenges that the achievement of the ESD goals faces using the current taxonomies.

4. Educational Taxonomies and Frameworks- ESD Challenges

Educational taxonomies and frameworks are structured models to organize educational objectives, content, and assessment methods. When applied to Education for Sustainable Development (ESD), they encounter several challenges hindering effective development and implementation. Firstly, the complexity of sustainability concepts poses a significant hurdle. Sustainability encompasses social, economic, and environmental dimensions, making it challenging to develop coherent taxonomies that adequately address these complexities. Secondly, ESD requires an interdisciplinary approach, integrating knowledge from diverse fields. This multidisciplinary nature makes it difficult to existing frameworks that capture the interconnectedness of disciplines while promoting holistic understanding (AlAfnan & Dishari, 2024).

Therefore, educational taxonomies and frameworks must be adaptable to diverse contexts. Achieving this adaptability while maintaining consistency across different settings is challenging, as ESD initiatives need to be tailored to specific local realities and priorities. Integrating sustainability principles into existing curricula also presents challenges. Taxonomies must align with established learning objectives and standards, ensuring that

sustainability concepts are integrated across subject areas and grade levels. Assessing students' understanding of ESD poses challenges due to the qualitative nature of sustainability concepts. Taxonomies must incorporate assessment methods beyond traditional measures, such as project-based learning and reflective practices (AlAfnan & Dishari, 2024).

Effective implementation of ESD relies on well-equipped educators. Taxonomies should provide educators with the tools and resources to integrate sustainability principles into their teaching practices. Engaging teachers is also critical for the success of ESD initiatives (Aaronson et al., 2007; Alam, 2023; Allen et al., 2016; Kioupi & Voulvoulis, 2019; Lim et al., 2018; Riechmann, 2018; Abati, 2023). Taxonomies should facilitate stakeholder collaboration to ensure diverse perspectives are considered in program development and implementation. Addressing these challenges requires a new taxonomy that integrates these challenges into the process. By recognizing and addressing these obstacles, educators can better harness the potential of ESD to empower learners with the knowledge, skills, and values needed for a sustainable future (AlAfnan & Dishari, 2024b).

As discussed in the following section, achieving ESD goals requires a new taxonomy, which is also needed to address the challenges presented by generative AI and large language models (LLMs).

5. Educational Taxonomies and Frameworks-Challenges in the AI era

Several researchers have outlined several reasons for poor performance in classrooms. Poor socioeconomic conditions (Howie et al., 2017; Mohangi et al., 2016), classroom overcrowding (Cilliers & Bloch, 2018; West & Meier, 2020), a lack of reading materials (Cilliers & Bloch, 2018; Mullis & Martin, 2017), the language of instruction not being their mother tongue (Plüddemann, 2018; Potgieter et al., 2018), a lack of parental involvement, and an unsupportive home environment (Howie et al., 2017; Taylor et al., 2014) are some of the reasons for learners' poor literacy (Pretorius et al., 2016; Taylor, 2016; Uwatt & Egbe, 2011). Low reading achievement and high learner dropout rates have also been linked to inadequately trained teachers. We add to these reasons AI challenges.

All educational taxonomies are established to offer frameworks that shall assist in establishing educational objectives and learning outcomes, achieving these educational objectives and learning outcomes, and assessing the achievement of the academic goals and learning outcomes. Scholars looked into education and learning as a process that starts but still needs to be finished. They expect students to acquire some basic knowledge first and then continue building on it to achieve learning. Learning is a process of components established in a hierarchy (Biggs & Collis, 1982; Bloom, 1956; Anderson & Krathwohl, 2001) or a non-hierarchy order (Fink, 2005).

These days, AI provides opportunities to students, but it also presents challenges (AlAfnan et al., 2023). As search engines present challenges to physical libraries, AI presents challenges to search engines as students do not need to search for information in a billion-plus provided results; they can generate the most likely accurate answer using AI applications. Students can also analyze, evaluate, and create material in its written, audio, visual, and audiovisual forms, as seen in Table 1. Students and professionals can initiate an AI task to generate text, images, videos, presentations, notes, transcriptions, and research papers and enhance any material simply by asking a question or providing a prompt or a scenario. The perception of receiving learning has changed.

These AI applications have been viewed as a challenge, but they have also been viewed as an opportunity. According to AlAfnan & Dishari (2024b), AI is used by students for (1) convenience, (2) time savings, (3) lack of time, (4) lack of curiosity, (5) lack of interest, (6) lack of knowledge, (7) lack of fundamental skills to complete tasks, (8) lack of confidence in abilities, (9) enthusiasm to score well on tests, and (10) to offer a new viewpoint. These reasons for using AI reflect character-based and academic perspectives (AlAfnan & Dishari, 2024b). The character-based perspective relates to students' attitudes toward learning and assessment. Some students do not consider education as a priority. They do understand the importance of learning as a pathway to achieve their future professional goals. As such, these students need to understand the importance of learning to achieve their future goals. The academic-based perspective, however, relates to a lack of practice in classrooms and teacher-centered teaching. Students did not fully comprehend the explained concepts, so they opted for the easy option of having their submissions auto-generated by an LLM.

Table 1. AI Applications-Functions, Names, and Usages (Adopted from AlAfnan et al., 2024)

AI Applications-Functions	Names	Uses
Chatbots	- ChatGPT - Bard	- Provide answers to prompts or questions. - Create content - Conduct research - Create correspondence
Content creation	- Jasper, - Copy.ai - Anyword.	- Provide templates for content creation - Enables AI image generation - Editing and proofreading
Text Enhancement	- Grammarly - Wordtune - ProWritingAid	- Spell and grammar checking - Enables tone adjustment - Provides shortcuts for complex or lengthy sentences - Provide suggested phrases
Video creation	- Descript - Wondershare Filmora - Runaway	- Turn videos into scripts - Editing the written script - Trimming the audio and video tracks using a timeline - Eliminate backgrounds - Denoise poor-quality recordings - Enhance sound quality - Create videos using artificial intelligence
Image-generation	- DALL·E 2 - Midjourney - Stable Diffusion	- Create images using options. - Create a background - Edit the background
Note-taking	- Mem	- Takes notes during meetings
Meeting transcription	- Fireflies	- Takes notes during classes
Inbox management	- SaneBox - EmailTree	- Writing emails - Getting rid of unnecessary emails - Setting priorities for messages - Adding tags to keep things organized
Presentation Slides	- Decktopus - SLidego - Beautiful.ai	- Creating presentations with text and slides - Editing images - Create new text - provides layouts and styles - Sets presentation's colors - Locates royalty-free photos in the library
Conduct research	- Genei - Aomni	- Read the article and provide suggestions - Providing extra material - Providing extra resources - Integrating the resources into the research

The availability and easy access to these LLMs changed the game's rules. Students have an option that can be, in general, used to accomplish their academic tasks. Motivation and engagement in classrooms, especially for the grade-centered students, decrease as they have other options. Hard-working students also have reasons to use LLMs as they can provide them with different perspectives (AlAfnan & Dishari, 2024b). The possibilities that AI and LLMs provide are enormous. They can generate knowledge, put knowledge into practice, apply knowledge, analyze information, evaluate scenarios, and create human-like writeups. We need a framework/taxonomy that addresses the recent developments. The needed taxonomy is a taxonomy that does not view these recent developments as a challenge. The needed taxonomy is a taxonomy that integrates these developments into the learning process to enhance learning further and reach new heights, as what used to be developed in days and weeks can be designed in minutes these days.

6. Proposing a New Taxonomy

As mentioned above, the AI era provides students new formal and informal learning platforms, means, and methods. It also changes their mindset regarding learning as the provided opportunities are enormous. From teachers' perspective, the AI era provides opportunities and some challenges. In addition, education these days is not only about the subject knowledge. In addition to the subject-specific knowledge, students are expected to establish a responsible attitude towards the globe regarding education for sustainable development goals. These days, students are also likely to develop soft skills to establish a competitive edge. Therefore, a new taxonomy is imperative. A taxonomy that **(1)** integrates the new realities into the landscape of learning, **(2)** maintains the classroom as the formal venue for learning, and **(3)** strengthens the position, role, and responsibility of teachers as facilitators who support every student to do their best. Designing a taxonomy for educational objectives in this era requires a balance between foundational knowledge and skills essential for the future workforce. The new taxonomy of educational objectives shall include six categories that are **(1)** Knowledge and Comprehension, **(2)** Synthesis and Evaluation, **(3)** Ethical and Moral Reasoning, **(4)** Application and Strategic Thinking, **(5)** Creativity and Innovation, and **(6)** Lifelong Learning and Adaptability. Figure 5 provides some insights into the proposed taxonomy.

Even though Bloom's original and revised taxonomies (Bloom et al., 1956; Anderson & Krathwohl, 2001) include knowledge and comprehension, on the one hand, and synthesis and evaluation, on the other hand, as four distinct categories, this proposed taxonomy included the first two categories and the latter two categories combined in 2 levels. Knowledge and comprehension are combined (level 1) as teaching knowledge shall lead to, on the same level, establishing comprehension. Using the student-centered approach, students are active participants in learning through practices that include, but are not limited to, discussions, brainstorming sessions, and workshops. As students work on remembering concepts, they shall do that through understanding, as memorizing without comprehension does not lead to retention. On the other hand, combining synthesis and evaluation into one category can provide a more holistic perspective on understanding and analyzing information. This acknowledges the close relationship between the two activities in practical scenarios. When evaluating information, learners often simultaneously synthesize, integrating diverse information to form a comprehensive understanding. This integration underscores the iterative nature of learning and decision-making. In practice, evaluation informs synthesis, and synthesis prompts reevaluation. By grouping these processes, the taxonomy emphasizes the interdependence of critical assessment and information synthesis, promoting a more integrated and nuanced approach to knowledge acquisition and problem-solving. The analysis is included in the second category of the proposed taxonomy.

In Bloom's original and revised taxonomies (Bloom et al., 1956; Anderson & Krathwohl, 2001), 'Apply'/ Application' was listed on the third level after 'Understand'/ 'Comprehension' and before 'Analyze'/Analysis.' The proposed taxonomy introduces 'Application and Strategic Thinking' as the fourth category of learning objectives and 'Ethical and Moral Reasoning' as the third category. Adding 'Application and Strategic Thinking' after 'Synthesis' and Evaluation' in the taxonomy extends the learning process beyond understanding and analysis. As learners have evaluated and synthesized information, the natural progression is toward applying this knowledge and employing strategic thinking. Application involves putting the synthesized information into practice, using it to solve problems, make decisions, or create innovative solutions in real-world situations. Strategic thinking encourages learners to consider the broader implications, anticipate future developments, and plan for long-term goals. This progression highlights the practical relevance of the acquired knowledge and emphasizes the importance of strategic planning and foresight in decision-making and problem-solving processes. Placing 'Ethical and Moral Reasoning' before 'Application and Strategic Thinking' reflects the foundational importance of ethical considerations in learning and production. Ethical and Moral Reasoning is the foundation for practical applications and strategic planning. Individuals first establish a solid ethical framework that guides their subsequent actions and strategic thinking by

addressing ethical and moral questions. Individuals first establish a solid ethical framework that guides their subsequent actions and strategic thinking by addressing ethical and moral questions.

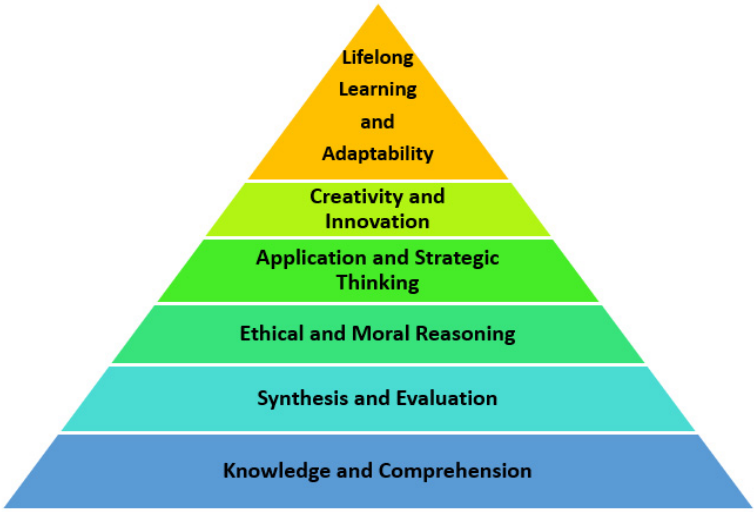

Figure 5. AlAfnan's Taxonomy of Educational Objectives

The last two categories in the proposed taxonomy are 'Creativity and Innovation' (level five) and 'Lifelong Learning and Adaptability' (level six). In today's rapidly changing world, creativity and innovation are crucial skills. They enable students to think critically, solve problems, and generate new ideas. By inspiring creativity and innovation, educators prepare students for future careers where adaptability and innovative thinking are highly valued. Learning continuously is valuable in a world where technology and knowledge constantly evolve. 'Lifelong Learning and Adaptability' emphasizes the importance of continuous education and staying updated with the latest developments. Teaching students how to learn, unlearn, and relearn prepares them for lifelong success in various fields. Adaptability and creativity are essential for understanding and appreciating diverse cultures and perspectives in a globalized world. These skills enable students to communicate effectively, collaborate across borders, and navigate multicultural environments. Incorporating 'Creativity and Innovation' and 'Lifelong Learning and Adaptability' into the teaching taxonomy reflects the modern educational approach that prepares students for the challenges of the future workforce and empowers them to become well-rounded, innovative, and adaptable individuals. These skills are valuable for professional success, personal growth, and meaningful societal contributions.

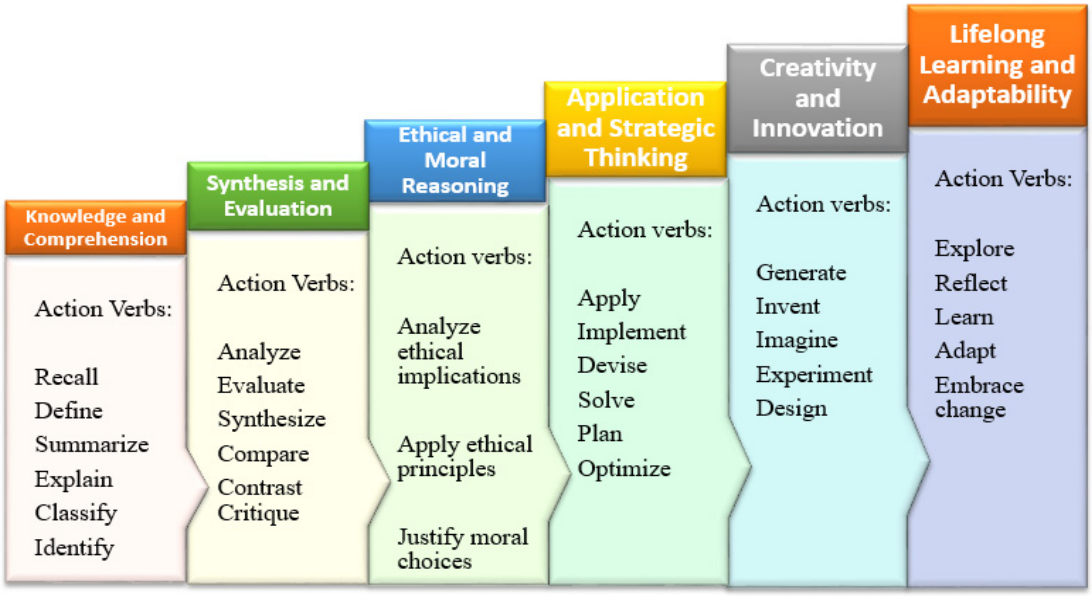

Figure 6. AlAfnan's Taxonomy with Action Verbs

The six levels are further explained below. Examples of action verbs are provided to illustrate the expected learning objectives at every level and the possible formatting of learning outcomes. This will also provide insights into creating assessments that would test the achievement of the proposed learning outcomes.

6.1 Knowledge and Comprehension

Knowledge and comprehension are the fundamental pillars of learning, pivotal in shaping a person's intellectual growth and cognitive abilities. These foundational elements form the basis for developing advanced skills and higher-order thinking. When students acquire knowledge, they gain a structured understanding of facts, concepts, and principles, effectively contextualizing new information. Comprehension, however, shall involve a deep understanding of the interconnections Between different pieces of information. A solid foundation in knowledge and comprehension instills confidence in learners. When individuals understand the basics of a subject, they are more likely to explore advanced topics and engage in intellectual pursuits with enthusiasm. This confidence becomes a driving force, encouraging further learning and exploration.

For this level of learning, learners shall be able to:

- **Define**: State a concept's meaning, significance, or nature.
- **Explain**: Provide detailed information, clarify ideas, or describe processes.
- **Summarize:** Condense information while retaining key points.
- **Recall**: Retrieve information from memory.
- **Classify**: Categorize items based on defined criteria.
- **Identify**: Recognize and name elements within a category.
- **Describe**: Provide characteristics or features of a specific topic.
- **Understand**: Grasp the meaning, nature, or significance of information.

Combining knowledge and comprehension under one level assists students in making sense of the learned concepts and knowledge. Students can use student-centered and constructivist approaches to teaching to make sense of knowledge and smoothly move the ladder to the comprehension level. In addition to teachers, students also have other resources they can use to develop their understanding and comprehension. The use of these resources shall be encouraged not only as part of informal learning but as part of formal learning. This is part of the integration of all resources in the educational process.

6.2 Synthesis and Evaluation

Synthesis and Evaluation play crucial roles in shaping learners into critical thinkers and problem solvers. Evaluation, as a skill, equips learners to assess information critically. It involves analyzing the quality, credibility, and relevance of ideas, arguments, or data. Through evaluation, learners can differentiate between trustworthy sources and misinformation, enabling them to make well-informed decisions. It promotes analytical thinking, teaching individuals to question assumptions, identify biases, and consider multiple perspectives. Moreover, evaluation instills a sense of intellectual responsibility, encouraging learners to base their beliefs and actions on reasoned judgment rather than mere acceptance. Synthesis involves integrating various information or ideas to create a coherent and meaningful whole. Enhances problem-solving skills by enabling individuals to devise innovative solutions by combining existing knowledge. Moreover, synthesis encourages interdisciplinary thinking, allowing learners to bridge gaps between different fields of study and explore diverse perspectives. This skill is essential in complex, real-world scenarios where solutions often require the integration of diverse knowledge and approaches.

In this level of learning, learners shall be able to:

- **Analyze**: Break down information into parts to understand its structure or relationships.
- **Evaluate**: Assess the quality, significance, or effectiveness of ideas, methods, or products.
- **Synthesize**: Combining elements to form a coherent whole generates new patterns or insights.
- **Compare**: Identify similarities and differences between concepts, theories, or processes.
- **Contrast**: Highlight the differences between two or more concepts or theories.
- **Critique**: Provide a detailed analysis, evaluation, or review, emphasizing strengths and weaknesses.

Synthesis and evaluation are not high-level thinking skills these days. In the era of open access, generative AI, and search engines with billions of results, these two categories shall be encouraged to assist students in their information

literacy and professional development. After introducing concepts and establishing understanding, students shall have access to other resources for the synthesis and evaluation process. AI can be integrated into the teaching process to generate responses at this level. Students will evaluate these responses to reach informative conclusions. Other resources, such as books and internet resources, shall also be introduced and integrated to assist students with synthesizing material.

6.3 Ethical and Moral Reasoning

Ethical and moral reasoning in learning is the ethical compass that guides learners in their intellectual pursuits and decision-making processes. It cultivates a deep sense of responsibility, integrity, and empathy, shaping learners into socially conscious and morally aware individuals. Ethical reasoning encourages learners to grapple with complex ethical dilemmas, enabling them to recognize and analyze the ethical dimensions of various situations. It prompts thoughtful consideration of the consequences of one's actions and decisions, fostering a heightened awareness of the impact one can have on others. Moral reasoning, on the other hand, provides a framework for evaluating actions and choices based on moral principles and values. It encourages learners to reflect on their beliefs and values, understanding the ethical implications of their decisions. Ethical and moral reasoning teaches learners to approach their studies and interactions with honesty, integrity, and respect for others. It prepares them to face ethical challenges in various fields.

In this level of learning, learners shall be able to:

- **Analyze Ethical Implications:** Consider the ethical consequences of various decisions or actions.
- **Apply Ethical Principles:** Use ethical theories or principles to guide decision-making.
- **Justify Moral Choices:** Provide reasons and arguments supporting moral or ethical decisions.
- **Evaluate Ethical Actions**: Assess the moral responsibility of individuals or organizations.

Education for Sustainable Development (ESD), social, legal, ethical, and environmental responsibilities shall be integrated and discussed here to assist students in developing integrity, commitment, and honesty. This is of core importance as teaching and learning shall focus more than just subject-specific knowledge from a technical perspective. Teaching and learning have ethical and moral responsibilities that shall be at the core of the process.

6.4 Application and Strategic Thinking

Application and strategic thinking are pivotal in learning as they bridge the gap between theoretical knowledge and practical implementation. They prepare learners for real-world challenges and opportunities. Applying knowledge is essential for translating learned concepts into tangible outcomes. It allows learners to use their understanding in real-life situations and enables them to solve problems, make informed decisions, and innovate. Strategic thinking complements application by teaching learners how to plan, anticipate, and make decisions with a long-term perspective. It involves analyzing situations from multiple angles, considering potential outcomes, and devising effective action plans. Strategic thinkers are adept at identifying patterns, understanding cause-and-effect relationships, and anticipating consequences. These skills are vital in complex, dynamic environments where learners must navigate uncertainties and make decisions that align with overarching goals.

In this level of learning, learners shall be able to:

- **Apply**: Use knowledge and skills in practical situations.
- **Implement**: Put plans or strategies into action.
- **Devise**: Create or invent a plan, system, or strategy.
- **Solve**: Find solutions to complex problems using strategic approaches.
- **Plan**: Develop a detailed proposal for achieving a specific goal or outcome.
- **Optimize**: Improve existing processes, strategies, or systems for better results.

The application and strategic thinking levels shall focus on putting the learned knowledge in perspective and on strategic thinking, which is paramount for navigating complex challenges and achieving long-term objectives. Strategic thinking enables proactive decision-making, anticipating trends, and effectively leveraging resources. Strategic thinking empowers students to adapt, thrive, and stay ahead in dynamic environments by aligning actions with overarching goals.

6.5 Creativity and Innovation

Creativity and innovation are fundamental in shaping learners into adaptable, forward-thinking, and inventive problem solvers. Creativity encourages learners to explore uncharted territories, connect seemingly unrelated concepts, and envision possibilities. Creativity promotes divergent thinking and enables learners to consider multiple angles, leading to innovative solutions. Moreover, creative approaches to learning make education engaging and enjoyable, sparking curiosity and a thirst for knowledge. On the other hand, innovation is the practical application of innovative ideas. It involves turning imaginative concepts into tangible products, services, or processes that positively change learning. Fostering innovation equips learners with the ability to solve complex problems. It encourages experimentation and learning from failure. Innovative thinking prepares learners to adapt to rapidly changing environments, a vital skill in today's fast-paced, technology-driven world.

In this level of learning, learners shall be able to:

- **Generate**: Produce new ideas, concepts, or solutions.
- **Invent**: Create original products, methods, or processes.
- **Imagine**: Conceive new possibilities, scenarios, or innovations.
- **Experiment**: Systematically test new ideas or approaches.
- **Design**: Plan and outline the structure or form of a product, system, or process.

Creativity and innovation inspire curiosity, engagement, and a thirst for knowledge, transforming education into a dynamic and enriching experience. Learning becomes more meaningful and effective by encouraging students to explore new ideas, experiment with different approaches, and express themselves creatively. Moreover, in an ever-evolving world, creativity and innovation equip learners with the skills and mindset needed to navigate uncertainty, drive progress, and shape the future.

6.6 Lifelong Learning and Adaptability

Lifelong Learning and Adaptability are fundamental in a rapidly changing world where knowledge evolves swiftly, and new challenges continually emerge. Lifelong learning ensures that learners stay intellectually engaged and updated with the latest developments in their field and beyond. Adaptability is critical in an era where technology and industries evolve unprecedentedly. The ability to adapt enables individuals to navigate shifting job markets, embrace new technologies, and acquire new skills. Lifelong learning goes hand in hand with adaptability, allowing individuals to continuously develop new knowledge and update existing skills. This not only enhances employability but also fosters a sense of confidence and resilience in the face of change. Lifelong learning and adaptability are skills and mindsets that prepare learners to thrive in an ever-changing world. They promote personal growth and career advancement. Embracing these qualities ensures learners remain agile, curious, and relevant by positively impacting their lives and the broader community.

In this level of learning, learners shall be able to:

- **Explore**: Investigate new topics or areas of interest.
- **Learn**: Acquire knowledge or skills through study, instruction, or experience.
- **Reflect**: Ponder on experiences and learning, extracting insights for future applications.
- **Adapt**: Adjust strategies, methods, or approaches to changing circumstances.
- **Embrace Change:** Accept and incorporate new ideas, technologies, or methodologies.

Continuous learning fosters personal growth, career advancement, and intellectual curiosity. Adaptability enables students to embrace new challenges, think critically, and navigate diverse environments effectively. Together, they empower learners to remain relevant, resilient, and thriving in an evolving educational landscape and dynamic workforce.

The taxonomy covers a broad spectrum of educational objectives, encompassing cognitive skills, practical abilities, ethical considerations, and future-ready competencies. Educators can use these categories to design learning experiences that address diverse aspects of students' development and prepare them for success in the current era.

7. Discussing the Taxonomy

This taxonomy encompasses a diverse range of skills and competencies that are essential and increasingly crucial in

the current era. It aligns education with the demands. It prepares students with knowledge and the ability to evaluate, think critically, make ethical decisions, apply knowledge practically, foster innovation, and adapt continuously. These skills are vital for personal and professional success and imperative for building a society that can effectively address the complex challenges and opportunities of the modern world. The taxonomy shall assist in creating a future generation that is educated but also adaptable, creative, ethical, and well-prepared for the challenges ahead.

'Knowledge and Comprehension' serve as the foundational pillars of education. This category involves grasping fundamental facts, theories, and concepts within a specific field. Learners should be able to recall, recognize, and understand information. In the current era, where information is abundant and easily accessible, fostering a deep understanding ensures students do not merely memorize facts but comprehend the underlying principles. This comprehension is vital for critical thinking and forms the basis for higher-order cognitive skills. To construct learning goals, objectives, and learning outcomes, on the one hand, and come up with questions to test the achievements of these learning outcomes, on the other hand, instructors may think of action verbs that include 'define,' 'list,' 'recall,' and 'understand.'

After grasping the subject knowledge and forming comprehension, instructors shall move to the second level in the taxonomy, 'Synthesis and Evaluation.' 'Synthesis and Evaluation' are imperative skills in a world inundated with data. The ability to critically evaluate information sources, discern credible information from misinformation, and synthesize diverse perspectives into coherent narratives are vital. These abilities are crucial for academic success and informed citizenship, and they enable individuals to make reasoned judgments in an era marked by information overload and complex global challenges. Instructors shall develop students' abilities to 'analyze,' 'asses,' 'compare,' 'contrast,' and 'synthesize' information based on the given context.

Students will be introduced to ethical and moral reasoning after developing the ability to analyze, assess, and synthesize. This category involves examining ethical dilemmas, moral principles, and value systems. Students should be able to justify their ethical decisions and critique moral arguments. In a world where ethical considerations in technology, business, and environmental practices are paramount, this category equips learners with the moral compass to make decisions that positively impact their academic and, later on, professional success. To form educational objectives, learning outcomes, and assessments, instructors may think of action verbs like 'debate,' 'argue,' 'justify,' 'evaluate,' and 'apply.' This category instills empathy and cultivates ethical leaders to ensure learners excel academically and contribute positively to their communities and the world.

After acquiring 'knowledge and understanding,' 'synthesis and evaluation,' and learning 'ethical and moral reasoning,' students shall be moved to the 'Application and Strategic Thinking' faze. The 'Application and Strategic Thinking' category focuses on applying knowledge in real-world contexts and devising long-term plans. The 'Application' involves using learned skills and knowledge in practical scenarios, while 'Strategic Thinking' requires students to anticipate future challenges, plan, and make decisions considering long-term consequences. Educators may consider action verbs that include 'apply', 'implement,' 'solve,' 'plan,' and 'forecast.' To construct learning objectives, outcomes, and assessments. In a rapidly changing world, applying knowledge practically and thinking strategically is invaluable. It prepares individuals for diverse careers and equips them with problem-solving skills for addressing complex global issues.

To further develop students' skills, the 'Creativity and Innovation' category shall follow to assist students to 'devise,' 'design,' 'invent,' 'imagine,' and 'integrate.' Creativity and Innovation are indispensable in a world characterized by rapid technological advancements. Encouraging creativity nurtures a mindset of exploration and experimentation and equips learners with the ability to adapt to new technologies and industries. Innovation, coupled with creativity, is the driving force behind solving complex problems and creating novel solutions to make it indispensable for progress. In the current era, where innovation drives progress, nurturing creative thinking prepares students for future careers and societal leadership roles. As mentioned above, instructors shall give students room and space to think outside the box and develop new thoughts, including integrating ideas and imagining new possibilities. In this regard, not all students shall be expected to create inventions and designs. Anticipating new opportunities, even theoretically, can also be accepted as a starting point.

The last category in the taxonomy is 'Lifelong Learning and Adaptability.' With the pace of change accelerating, instilling a mindset of 'Lifelong Learning and Adaptability' is crucial. This category emphasizes the importance of continuous learning, staying updated with new information, and adapting to evolving circumstances. Instructors may use action verbs that include 'learn,' 'adapt,' 'embrace change,' 'acquire,' and 'explore' to form learning objectives/outcomes and assessment questions. In an era where skills become obsolete rapidly, nurturing a habit of continuous learning and a growth mindset ensures individuals remain competitive and relevant to prepare them for a

future where adaptability is critical to success.

This taxonomy includes categories that were also included in previous categories. Knowledge, comprehension, evaluation, synthesis, and application are all categories that were included in Bloom's original and revised categories. However, in this taxonomy, 'knowledge and comprehension' and 'synthesis and evaluation' are grouped into two categories. With recent developments in teaching pedagogy and emphasis on student-centered and constructivist approaches (Abdoh, 2022; Dishari et al., 2023; AlAfnan et al., 2024; Dishari, & AlAfnan, 2023a; Dishari & AlAfnan, 2023b; AlAfnan & Dishari, 2024; Abrahams, 2018) and practices in teaching, students are empowered. Students take the driving seat, and teachers become facilitators. As such, knowledge is believed to be combined with comprehension at a single learning objective level, which is an approach that considers students' ability to recall or remember ideas without understanding them as learning. Similarly, synthesis and evaluation are also combined through the use of constructivist and student-centered approaches, the development of student's abilities to evaluate (i.e., compare, conclude, contrast, criticize) and synthesize (i.e., rearrange, reconstruct, relate, reorganize, revise, rewrite) shall be placed within the same level.

This taxonomy also included new learning categories that should have been included in other categories. 'Application,' the third category in Bloom's taxonomy, was introduced as the fourth category in this taxonomy, along with 'Strategic Thinking.' 'Application' shall be introduced to students after developing the 'evaluating' and 'synthesizing' abilities as 'application,' in this taxonomy includes production. 'Application' in this category can be considered the equivalent of 'create' in Bloom's revised taxonomy, which was listed as the highest level of learning. As applying the learned knowledge to create and produce new wholes shall always be context-based, the 'application' was combined with 'strategic thinking.' 'Strategic Thinking' implies thinking critically, planning for the future, anticipating consequences, and making decisions that align with long-term goals and objectives. This combination emphasizes the practical application of knowledge and the importance of considering the broader context and implications. These two are listed after 'ethical and moral reasoning' (level 3), as education is not just about acquiring knowledge but also about shaping character. Ethical and moral reasoning helps students develop a strong moral compass, guiding them to make principled decisions and act ethically in various situations. This shall be the basis for the 'application,' 'strategic thinking,' 'creativity,' 'innovation,' 'lifelong learning,' and 'adaptability.'

The last two categories of the taxonomy are 'creativity and innovation' and 'lifelong learning and adaptability,' respectively. In the present era, setting creativity and innovation, promoting lifelong learning and adaptability as learning objectives is paramount for learners—the rapid pace of technological advancements and the constantly evolving global landscape demand new skills. Creativity and innovation are key drivers of progress in this era. Encouraging creative thinking nurtures problem-solving skills, enabling individuals to approach challenges with fresh perspectives and devise novel solutions. In a world where the only constant is change, fostering adaptability and a habit of lifelong learning equips individuals with the ability to quickly grasp new concepts, acquire new skills, and navigate different environments. Additionally, a commitment to lifelong learning ensures that students and future professionals remain up-to-date in their fields, enhancing their career prospects and employability. Teaching creativity and innovation and promoting lifelong learning and adaptability prepare learners to thrive in a dynamic world. These skills are not just advantageous; they are essential for learners to lead, contribute meaningfully, and navigate the challenges and opportunities of the modern era.

In essence, this taxonomy offers a holistic approach to education, aligning with the demands of the current era. By fostering a deep understanding, critical thinking, ethical awareness, practical application, creativity, and adaptability, this taxonomy equips learners with the multifaceted skill set necessary to thrive in an ever-changing world, making it relevant and essential for contemporary education.

8. Conclusion

This study is carried out with the objectives of reviewing existing taxonomies of educational objectives and proposing a new educational taxonomy of educational objectives suitable for the current era, the information and AI era. The review of previous educational taxonomies revealed that although they provide some very comprehensive insights into setting learning and assessment objectives, they were also the target of critique. This study proposes a new taxonomy for educational objectives that considers students' and instructors' current and future needs. The new taxonomy intends to (1) integrate the new realities into the landscape of learning, (2) maintain the classroom as the formal venue for learning, and (3) strengthen the position, role, and responsibility of teachers as facilitators who support every student to do their best thinking and practice. As designing a taxonomy for educational objectives in the current era requires a balance between knowledge and skills that are essential for the future workforce, the new

taxonomy has six hierarchical levels that are (1) Knowledge and Comprehension, (2) Synthesis and Evaluation, (3) Ethical and Moral Reasoning, (4) Application and Strategic Thinking, (5) Creativity and Innovation, and (6) Lifelong Learning and Adaptability.

It is believed that this taxonomy will enrich the teaching and learning experience as it enables education to meet the needs of the modern world. In addition to knowledge, it also equips students with the skills necessary for evaluation, critical thought, moral judgment, practical application of knowledge, the promotion of innovation, and ongoing adaptation. These abilities are necessary for creating learners who can successfully address the complex possibilities and problems of the modern world. It is also believed that this taxonomy will provide learners with the needed tools to prosper in the ever-evolving world, guaranteeing that the next generation is educated but also flexible, inventive, moral, and well-equipped for the challenges ahead.

References

Aaronson, D., Barrow, L., & Sander, W. (2007). Teachers and student achievement in the Chicago public high schools. *Journal of labor Economics*, *25*(1), 95-135. https://doi.org/10.1086/508733

Abate, D. W. (2023). Bacha Kebede Debela, Geert Bouckaert, Meheret Ayenew Warota, and Dereje Terefe Gemechu. Public Administration in Ethiopia: Case Studies and Lessons for Sustainable Development. Leuven: Leuven University Press, 2021. 680 pg. References (by chapter). $59.00. Paper. ISBN: 78-9462702561. *African Studies Review*, *66*(1), 253-254. https://doi.org/10.1017/asr.2022.146

Abdoh, S. A. (2022). Art and sustainability: can digital technologies achieve sustainability?. *Journal of Cultural Heritage Management and Sustainable Development*. https://doi.org/10.1108/JCHMSD-03-2022-0038

Abrahams, D. (2018). Local economic development in South Africa: A useful tool for sustainable development. In *Local economic development in the changing world* (pp. 131-145). Routledge.

Abrahamson, D., & Sánchez-García, R. (2016). Learning is moving in new ways: The ecological dynamics of mathematics education. *Journal of the Learning Sciences*, *25*(2), 203-239. https://doi.org/10.1080/10508406.2016.1143370

AlAfnan, M. A. Dishari, S., Jovic, M., & Lomidze, K. (2023). ChatGPT as an educational tool: Opportunities, challenges, and recommendations for communication, business writing, and composition courses. *Journal of Artificial Intelligence and Technology*, *3*(2), 60-68. https://doi.org/10.37965/jait.2023.0184

AlAfnan, M. A., & Dishari, S. (2024). ESD goals and soft skills competencies through constructivist approaches to teaching: an integrative review. *Journal of Education and Learning (EduLearn)*, *18*(3), 708-718. https://doi.org/10.11591/edulearn.v18i3.21408

AlAfnan, M. A., & MohdZuki, S. F. (2023). Do artificial intelligence chatbots have a writing style? An investigation into the stylistic features of ChatGPT-4. *Journal of Artificial Intelligence and Technology*, *3*(3), 85-94. https://doi.org/10.37965/jait.2023.0267

AlAfnan, M. A., Dishari, S., & Siti Fatimah MohdZuki. (2024). Developing Soft Skills in the Artificial Intelligence Era: Communication, Business Writing, and Composition Skills. *Journal of Artificial Intelligence and Technology*. https://doi.org/10.37965/jait.2024.0496

Alam, A. (2022). Mapping a sustainable future through the conceptualization of transformative learning framework, education for sustainable development, critical reflection, and responsible citizenship: an exploration of pedagogies for twenty-first-century learning. *ECS Transactions*, *107*(1), 9827. https://doi.org/10.1149/10701.9827ecst

Allen, C., Metternicht, G., & Wiedmann, T. (2016). National pathways to the Sustainable Development Goals (SDGs): A comparative review of scenario modeling tools. *Environmental Science & Policy*, *66*, 199-207. https://doi.org/10.1016/j.envsci.2016.09.008

Almeida, F., & Morais, J. (2021). Strategies for developing soft skills among higher engineering courses. *Journal of Education, 1*(1), 1-10. https://doi.org/10.1177/00220574211016417

Amer, A. (2006). Reflections on Bloom's revised taxonomy. *Electronic Journal of Research in Education Psychology*, *8*(4), 214-230.

Anderson, L. W., Krathwohl, D. R., & Bloom, B. S. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. New York: Longman.

Biggs, J. B. (N.A). Solo taxonomy. Retrieved from https://www.johnbiggs.com.au/academic/solo-taxonomy/

Biggs, J. B., & Collis, K. (1982). *Evaluating the quality of learning: the SOLO taxonomy*. New York, NY: Academic Press.

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956*). Taxonomy of educational objectives: The classification of educational goals*. Vol. Handbook I: Cognitive domain. New York, NY: David McKay Company.

Cilliers, L., & Bloch, C. (2018). A reading project to improve literacy in the foundation phase: A case study in the eastern cape. J. Read. *Ass. S. Afr*., *9*(1), 1-7. https://doi.org/10.4102/rw.v9i1.167

Clarkson, P., Bishop, A., & Seah, W. T. (2010). Mathematics education and student values: The cultivation of mathematical wellbeing. In T. Lovat, R. Toomey, & N. Clement (Eds.), *International research handbook on values education and student wellbeing* (pp. 111-135). Springer. https://doi.org/10.1007/978-90-481-8675-4_7

Dave, R. H. (1970). Psychomotor levels. *In developing and writing behavioral objectives* (Ed.), Robert J. Armstrong. Tucson AZ: Educational Innovators Press.

DeBellis, V., & Golding, G. (2006). Affect and meta-affect in mathematical problem solving: A representational perspective. *Educational Studies in Mathematics*, *63*(2), 131-147. https://doi.org/10.1007/s10649-006-9026-4

Dishari, S., & AlAfnan, M. A. (2023a). Teaching Literature through an Emotional Intelligence Model: Psychological Impacts on Academic Performance. *Journal for ReAttach Therapy and Developmental Diversities*, *6*(10s), 439-451.

Dishari, S., & AlAfnan, M. A. (2023b). Gender differences in teaching literature through an emotional intelligence model. *Educational Administration: Theory and Practice*, *29*(3). https://doi.org/10.52152/kuey.v29i3.709

Dishari, S., AlAfnan, M. A., & Lee, L. (2023). Reframing constructivism for better authentic teaching and learning. *Journal of Namibian Studies: History Politics Culture*, *34*, 3141-3155.

Dosmar, E., & Nguyen, B, (2021). *Applying the framework of Fink's taxonomy to the design of a holistic culminating assessment of student learning in biomedical engineering*. ASEE Annual Conference. https://doi.org/10.18260/1-2--36695

Fink, L. D. (2003). *Creating significant learning experiences: An integrated approach to designing college courses*. San Francisco, CA: Jossey-Bass.

Fink, L. D. (2005, August). *Self-directed guide for designing courses for significant learning*. Retrieved from http://www.deefinkandassociates.com/GuidetoCourseDesignAug05.pdf

Forehand, M. (2005). Bloom's taxonomy: Original and revised. In M. Orey (Ed.), *Emerging perspectives on learning, teaching, and technology*. Retrieved from: http://projects.coe.uga.edu/eppltt.

Gulzar, A. A. (2021). *SOLO taxonomy*. Educare. Retrieved from https://educarepk.com/solo-taxonomy.html

Howie, S. J., Combrinck, C., Roux, K., Tshele, M., Mokoena, G., & McLeod Palane, N. (2017). *PIRLS literacy 2016: South African highlights report (Grade 4)*. Centre for Evaluation and Assessment (CEA).

Kioupi, V., & Voulvoulis, N. (2019). Education for sustainable development: A systemic framework for connecting the SDGs to educational outcomes. *Sustainability*, *11*(21), 6104. https://doi.org/10.3390/su11216104

Krathwohl, D. R. (2002). A revision of Bloom's taxonomy: An overview. *Theory into Practice*, *41*(4), 212-218. https://doi.org/10.1207/s15430421tip4104_2

Krathwohl, D. R., Bloom, B. S., & Masia, B. B. (1964). *Taxonomy of educational objectives: Handbook II: Affective domain*. New York, NY: David McKay Co.

Lim, M. M., Jørgensen, P. S., & Wyborn, C. A. (2018). Reframing the sustainable development goals to achieve sustainable development in the Anthropocene—a systems approach. *Ecology and Society*, *23*(3). https://doi.org/10.5751/ES-10182-230322

Marzano, R. J. (2000). Introduction to the special section implementing standards in schools updating the standards movement. *NASSP Bulletin*, *84*(620), 2-4. https://doi.org/10.1177/019263650008462001

Mohangi, K., Krog, S., Stephens, O., & Nel, N. (2016). Contextual challenges in early literacy teaching and learning in Grade R rural school in South Africa. *Per Linguam*, *32*(1), 71-87. https://doi.org/10.5785/32-1-646.

Mullis, I. V., & Martin, M. O. (2017). *TIMSS 2019 Assessment Frameworks*. International Association for the

Evaluation of Educational Achievement. Herengracht 487, Amsterdam, 1017 BT, The Netherlands.

North Island College, (2023). *Fink*. Retrieved from https://teachanywhere.opened.ca/course-design/learning-outcomes/classifications-of-learning/fink/

Pickard, M. J. (2007). The new Bloom's taxonomy: An overview for family and consumer Sciences. *Journal of Family and Consumer Sciences Education*, *25*(1), 45-55.

Plüddemann, P. (2018). Unlocking the grid: Language-in-education policy realisation in post-apartheid South Africa. In *Language in Epistemic Access* (pp. 10-23). Routledge. https://doi.org/10.4324/9781315229744-2

Polya, G. (1957). *How to solve it. A new aspect of mathematical method*. Princeton, NJ: Princeton University Press.

Potgieter, J. M., Swanepoel, D. W., Myburgh, H. C., & Smits, C. (2018). The South African English smartphone digits-in-noise hearing test: Effect of age, hearing loss, and speaking competence. *Ear and hearing*, *39*(4), 656-663. https://doi.org/10.1097/AUD.0000000000000522

Pretorius, E. J., Jackson, M. J., McKay, V., Murray, S., & Spaull, N. (2016). Teaching reading (and writing) in the foundation phase. *ZENEX Foundation*.

Puentedura, R. (2006). *Transformation, technology, and education*. Retrieved from http://hippasus.com/resources/tte/

Rieckmann, M. (2018). Learning to transform the world: Key competencies in Education for Sustainable Development. *Issues and trends in education for sustainable development*, *39*(1), 39-59.

Shulman, L. (2004). *Teaching as community property: Essays on higher education*. Jossey-Bass.

Simpson, E. (1972). *The classification of educational objectives in the psychomotor domain: The psychomotor domain*. Washington, DC: Gryphon House.

Soozandehfar, S., & Adeli, M. (2016). Acritical appraisal of Bloom's taxonomy. *American Research Journal of English and Literature*, *2*, 1-9. https://doi.org/10.21694/2378-9026.16014.

Sprecher, E. A. (2019). Back to the chalkboard: Lessons in scaffolding using SOLO taxonomy from school teachers for university educators. *Psychology Teaching Review*, *25*(2), 95-102. https://doi.org/10.53841/bpsptr.2019.25.2.95

Startalk. (2009). *Designing effective projects: Thinking skills frameworks Bloom's taxonomy*. Retrieved from http://startalk.umd.edu/teacher-development/workshop/2009/

Suvin, M. C. (2023). *Designing effective learning outcomes with Solo taxonomy in higher education.* Creatrix Campus. Retrieved from https://www.creatrixcampus.com/blog/designing-effective-learning-outcomes-solo-taxonomy-higher-education

Taylor, N. (2016). Thinking, language and learning in initial teacher education. *Perspectives in Education*, *34*(1), 10-26. https://doi.org/10.18820/2519593X/pie.v34i1.2

Taylor, N., Sithole, S., & Mayer, L. (2014). *NEEDU national report 2014: The quality of learning outcomes: Reducing the inequalities at the higher levels of schooling in South Africa*. Pretoria: Department of Basic Education.

UNESCO. (2014). Education for sustainable development. Retrieved from: https://www.unesco.org/en/education/sustainable-development.

Uwatt, L. E., & Egbe, G. B. (2011). A literacy intervention for struggling readers in Nigeria. *Mousaion*, *29*(1), 136-154.

Webb, N. (1997). *Criteria for alignment of expectations and assessments in mathematics and science education* (Research Monograph No. 6). National Institute for Science Education. Retrieved from https://eric.ed.gov/?id=ED414305

West, J., & Meier, C. (2020). Overcrowded classrooms–the Achilles heel of South African education?. *South African Journal of Childhood Education*, *10*(1), 1-10. https://doi.org/10.4102/sajce.v10i1.617

Acknowledgments

I would like to acknowledge my family for their continious support.

Authors contributions

Dr. Mohammad Awad Alafnan wrote the entire article.

Funding

No finding received for this article.

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Sciedu Press.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.