

BLOOM'S TAXONOMY FOR THE DIGITAL AGE STUDENT IN A RURAL AFRICAN CONTEXT

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Abstract

Bloom's Taxonomy serves as an important guide for teachers in building their student's cognition from low to high order thinking. This taxonomy has been widely implemented in face-to-face settings worldwide. With the increased use of technology and blended and online learning on the rise, there is a need for teachers to warm up to digital learning. Teachers must be innovative in using technology to improve the quality of education and its delivery. Bloom's Digital Taxonomy serves as an updated original Bloom's Taxonomy for designing technology-rich instruction for quality outcomes. This qualitative study explores the use of technology and digital tools to facilitate student learning experiences and outcomes in the modern era. The secondary data collected and analyzed was gathered from existing sources of information. The study recommends that for teachers to be proficient and achieve the best outcomes and add incentives for the students, there is a need to follow the utilization of Bloom's Digital Taxonomy and consolidate innovation, following the application will get students closer to accomplishing their learning objectives. Teachers need support to prevent forestall disdain and advancement weariness. To conclude the Bloom Digital Taxonomy is well practised in classrooms, and teachers can rest assured that the students they produce will make a difference in this world through the skills they have accumulated during their schooling years.

Keywords: bloom taxonomy, digital technology, blooms digital taxonomy, rural learners, African education.

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1. Introduction

"Success provides confidence, security, a sense of well-being, the ability to contribute at a greater level, hope and leadership," [1]. Every parent wants their child to be successful in life and one way that has been identified as key to ensuring success is education. Parents, therefore, take their children to school to get an education. The people are responsible for ensuring that the dreams and wishes of the parents for their children to achieve success are put in the hands of the teachers. Teachers are given the responsibility to provide learning experiences for the students, which ensure that the dreams of the parents come true. The education they provide must be increasingly concerned about the whole development of all individuals or learners, and it is the responsibility of the school management, including teachers, to seek learning conditions that will enable individuals to reach the highest level of learning possible [2]. According to the Sustainable development Goals (SDGs) United Nations Educational, Scientific and Cultural Organization's (UNESCO's) agenda for 2030, the task of education is to offer children tools and strategies for access to knowledge, criteria for interpreting, abilities, and knowledge for living and growing in their life contexts. The SDG goal four states, 'to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all both rural and urban environments [3].

Noting the importance of education for children, King [4] posits that Early learning skills pave the way for a lifetime of learning. The traditional concept of education, which begins in pri-

mary school, begins too late in life to meet the issue. Education should be encouraged early and often, both inside and outside of the formal schooling system, according to the Science of Brain Development (year). Programs that include prenatal health and early childhood development are good examples of informal education before children start schooling. The author stresses that quality instruction is critical in the early years to provide pupils with the core reading and numeracy skills for lifelong learning.

To bridge the gap between teachers and students at an early age for sustainable pedagogical delivery Benjamin Bloom developed a learning theory, known as Bloom's Taxonomy, which provides a framework for developing strong learning objectives for children [2]. Bloom's Taxonomy serves as a toolbox that teachers and students can use to classify and organise learning objectives. However, when it was created in 1956 eLearning did not exist; it was intended for in-class style teaching training. Therefore, the thrust of this article is how can this learning theory, Bloom's Taxonomy be adapted to create strong learning objectives through digital technology for children in a rural classroom setting in this era.

In recent times, studies have indicated that today's students, regardless of demographics, have shown an interest in digital learning opportunities, and the range of Web or mobile technology that enables collaboration, innovation, and individual exploration is incredible [5–7]. According to [6], providing students with authentic learning experiences is a critical component of digital learning. An ongoing debate is how teachers and all other stakeholders provide meaningful learning experiences for students using intrinsically motivating tools. However, the debate of such needs to provide teachers with an innovative way of integrating digital technology that can encourage higher-order critical thinking skills and creativity among children/ students.

In closing the gap, this study seeks to provide a guide for teachers on how to use technology and digital tools to facilitate the student learning experience and outcomes using the framework of Bloom's Revised Taxonomy, most especially in the rural African context.

1. 1. Conceptualization of terms

Bloom's Taxonomy: Bloom's taxonomy is a set of three hierarchical models, used to categorize educational learning objectives according to their complexity and specificity. The models categorize learning objectives into three categories: cognitive, affective, and sensory/psychomotor. However, the focus of this paper is on the cognitive domain.

Digital/Technology: Technology is the application of scientific knowledge to the practical aims of human life, which promote the use of gadgets, devices, and equipment as well as online network [8]. In other words, technology creates an opportunity for students to learn using online platforms. In this study, technology is a form of learning that requires teaching to be modernised and flexible using various technological tools.

Digital Bloom's Taxonomy: It is a form of selecting an appropriate digital tool by the teacher based on the kind of learning experiences the students need to acquire.

Children/Students: The word children vary from place to place [9], according to the [10], refers the word child to anyone under 18 years unless, under the law applicable to the child, majorly attained earlier. Merriam-Webster dictionary defines a child as a young person, especially between infancy and puberty. However, a report, conducted by [11], affirmed that there are some 18 years old individuals who are still children because of a lack of awareness and experience in life, making them incapable of taking the right actions or decisions. For this study, the word students and children are used interchangeably.

Rural Area: Rural area varies according to location [12] as well as Akintolu and [8]. Rural areas in developed countries are distinct from those in developing or underdeveloped countries, the majority of which are African. This is due to the characteristics that distinguish each of these regions. For instance, [13] affirm that these are locations that are largely characterized by underdevelopment, high rate of poverty, illiteracy, untarred roads, poor electricity supply, and poor internet connectivity among others. In the context of this study, rurality implies areas within the African continent that are characterized by high levels of illiteracy, unemployment, poverty, and untarred and poor road networks.

Rural African context: These are specific strategic locations within and around African settlements that lack development, high levels of illiteracy, poverty, and poor road networks.

1. 2. Rationale of the study

The purpose of this study is to explore the use of technology and digital tools to facilitate student learning experiences and outcomes in this era. The original Bloom's taxonomy served as an excellent tool for guiding teachers in the 50s going forward. The revision, done by Krathwohl and his team, enabled teachers to implement Bloom's Taxonomy in the 90s. The Covid-19 pandemic has pushed many teaching and learning institutions to online learning after closure to control the spread of the virus. While some teaching and learning institutions are back to face-to-face, others are still fully online. Even those who are back have adopted the blended learning method. Blended learning is a term, coined in the late 1990s [14], which refers to combining face-to-face and computer-mediated learning [15]. Bloom's Taxonomy has generally been used in face-to-face situations; this study explores how it can be made relevant in today's classrooms. This study attempts to show teachers how to embed digital technology in Bloom's Taxonomy to facilitate students learning experiences and outcomes. This study expands upon the skills, associated with each level of bloom's taxonomy as technology becomes a more ingrained essential part of learning.

2. Material and Methods

This study employed a qualitative approach with an exploratory research design. The broad aim of this study is to systematically review relevant kinds of literature that present an insight into the bloom digital taxonomy and its relevance to education, centred on digital-age students in a rural context. The input of data review is generated by the combination of secondary data from multiple discussions relating to the subject matter. The databases consulted are google scholar, articles on springer link and Taylor and Francis as well as data and reports from international organisations.

3. Result

3. 1. An overview of bloom's taxonomy

The cognitive domain of Bloom's Taxonomy is the most popular one, hence this study's focus. It assumes that learning should be structured from easy to difficult in the following 6 step levels, arranged from the least to the most difficult level:

- 1) knowledge;
- 2) comprehension;
- 3) application;
- 4) analysis;
- 5) synthesis;
- 6) evaluation.

The original Bloom's Taxonomy served educators well, but a group deemed it important to revise it such that it is more user-friendly. This classification of human cognition, which includes thinking, learning and understanding, is a good tool to guide instructional activities as well as assessment in the classroom. These levels are organized in a hierarchy, the bottom three levels (knowledge, comprehension and application) being the most basic levels of cognition, referred to as lower-order thinking, and the top three levels (analysis, synthesis, evaluation) being higher-order thinking skills. Teachers use this taxonomy to structure the learning process and guide students from low to high levels of thinking in their learning experiences. A group of researchers, led by David Krathworl and Lorin Anderson, saw a need to revise this taxonomy in the late 90s to make it more relevant and easily usable by 21st-century teachers in their classrooms. The major change they came with was changing the nouns in the hierarchy to verbs. The reasoning was to bring an action to the hierarchy, since learning is an active process rather than a passive one [16]. The nouns were then replaced by action words, i. e. remember, understand, apply, analyse, evaluate and create. They also re-arranged the top two levels, synthesis and evaluation to start with synthesising and then creating. The changes are clearer in the **Fig. 1**, taken from David Krathwohl.

Structure of the Original Taxonomy	Dimension of the Revised Taxonomy
1.0 Knowledge 1.10 Knowledge of specifics 1.11 Knowledge of terminology 1.12 Knowledge of specific facts 1.20 Knowledge of ways and means of dealing with specifics 1.21 Knowledge of conventions 1.22 Knowledge of trends and sequences 1.23 Knowledge of classifications and categories 1.24 Knowledge of criteria 1.25 Knowledge of methodology 1.30 Knowledge of universals and abstractions in a field 1.31 Knowledge of principles and generalizations 1.32 Knowledge of theories and structures 2.0 Comprehension 2.1 Translation 2.2 Interpretation 2.3 Extrapolation 3.0 Application 4.0 Analysis 4.1 Analysis of elements 4.2 Analysis of relationships 4.3 Analysis of organizational principles 5.0 Synthesis 5.1 Production of a unique communication 5.2 Production of a plan, or proposed set of operations 5.3 Derivation of a set of abstract relations 6.0 Evaluation 6.1 Evaluation in terms of internal evidence 6.2 Judgments in terms of external criteria	1.0 Remember – Retrieving relevant knowledge from long-term memory. 1.1 Recognizing 1.2 Recalling 2.0 Understand – Determining the meaning of instructional messages, including oral, written, and graphic communication. 2.1 Interpreting 2.2 Exemplifying 2.3 Classifying 2.4 Summarizing 2.5 Inferring 2.6 Comparing 2.7 Explaining 3.0 Apply – Carrying out or using a procedure in a given situation. 3.1 Executing 3.2 Implementing 4.0 Analyze – Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose. 4.1 Differentiating 4.2 Organizing 4.3 Attributing 5.0 Evaluate – Making judgments based on criteria and standards. 5.1 Checking 5.2 Critiquing 6.0 Create – Putting elements together to form a novel, coherent whole or make an original product. 6.1 Generating 6.2 Planning 6.3 Producing

Fig. 1. Bloom's Taxonomy revision [17]

Knowledge is the basis of the six cognitive processes: remember, understand, apply, analyze, evaluate, and create. The authors of the new framework also identified different types of knowledge used in cognition: factual knowledge, conceptual knowledge, procedural knowledge, and metacognitive knowledge.

The lower-order thinking skills remain at the base of the pyramid with the higher-order skills at the pinnacle.

3. 2. Level of Bloom's Taxonomy

The first level is remembered. On the first level, we learn to remember. At this level, there is just rote memorization and recollection of facts without much understanding. For example, if we learn about lemons, we want to remember their name, shape, colour, and size and that they are sour. Once we memorized these essentially meaningless facts, we move to the second level of learning.

The second level is understood. On the second level, we begin to decode information and learn that a lemon is yellow when it is ripe to eat, and if we take a bite, it is super sour. Furthermore, we also understand that lemons love sunshine and that they contain lots of vitamin C, which is a great natural antioxidant that keeps us healthy. Hence, as we understand a lemon, we can work with it.

The third level is applied. On the third level, we apply what we know. We have understood that while lemons are sour, they are also a great provider of vitamin C. To apply this knowledge in a meaningful way. We could boil a lemon in hot water and add some honey. Then serve this hot lemon to our sick sister, who needs treatment.

The fourth level is analysed. On the fourth level, we learn to analyse. This involves examining and breaking down information into components, determining how the parts relate to one another and finding evidence to support generalizations. We study the lemon flesh, examine the skin and look at the levels of vitamins. We conclude that we can eat everything inside, while the skin tastes bitter and contains traces of toxic pesticides. It ought not to be consumed.

The fifth level is evaluation. On this level, we analyse, critique and compare. For example, to evaluate our lemon as a good source of vitamins, we compare it to other sources, such as oranges, grapes and supplements. In this case, we consider the following properties: vitamin levels, affordability, taste, and packaging waste. If we evaluate our thoughts critically and without bias, we learn where the lemons score high and where others score higher.

The sixth and final level is created. Now after we have learned, understood, applied, analyzed and evaluated, we are ready to create. As we now really understand lemons, also in comparison to similar things, we can formulate a plan to create our natural lemonade. It is now easy to come up with a cute shop design, a good name sweet lemon and a good slogan natural healthy yummy.

So, to design learning activities for children using digital bloom taxonomy, it is important to put all six levels into consideration. As educators and administrators, we need to design content that will engage and provoke critical thinking and problem-solving skills in these learners by putting different alternative approaches into consideration as highlighted in the example of lemonade above.

3. 3. Bloom's Taxonomy Power Verbs

Remembering

Copying, Defining, Finding, Locating, Quoting, Listening, Googling, Repeating, Retrieving, Outlining, Highlighting, Memorizing, Networking, Searching, Identifying, Selecting, Tabulating, Duplicating, Matching, Curating & Bookmarking and Bullet-pointing.

Understanding

Annotating, Tweeting, Associating, Tagging (tagging your curriculum for example), Summarizing, Relating, Categorizing, Paraphrasing, Predicting, Comparing, Contrasting, Commenting, Journaling, Interpreting, Grouping, Inferring, Estimating, Extending, Gathering, Exemplifying and Expressing.

Applying

Acting out, Articulate, Reenact, Loading, Choosing, Determining, Displaying, Revising Search Keywords, Executing, Examining, Implementing, Sketching, Experimenting, Hacking, Interviewing, Painting, Preparing, Playing, Integrating, Presenting and Charting.

Analyzing

Calculating, Categorizing (e. g., web content, search results, etc.), Breaking Down, Correlating, Deconstructing, Strategic Hyperlinking, Supporting (e. g., a cause), Mind-Mapping, Organizing, Appraising, Advertising, Dividing, Deducing, Distinguishing, Illustrating, Questioning, Structuring, Integrating, Attributing, Estimating and Explaining.

Evaluating

Arguing & Debating, Validating, Testing, Scoring, Assessing, Criticizing, Commenting, Iterating or Pivoting (e. g., a startup or app), Defending, Detecting, Experimenting, Grading, Hypothesizing, Judging, Moderating, Posting, Predicting, Rating, Reflecting, Reviewing (e. g., a service or platform) and Editorializing.

Creating

Blogging, Building, Animating, Adapting, Collaborating, Composing, Directing, Devising, Podcasting, Wiki Building, Writing, Filming, Programming, Simulating, Role-Playing, Solving, Remixing, Facilitating Designing a Presentation (Prezi or YouTube Channel), Negotiating and Leading

3. 4. Why bloom's taxonomy

Bloom's Taxonomy helps provoke critical thinking and problem-solving in learners. In addition, it elicits innate talents in learners. The learning methodology in a typical African learning space limits learning outcome to the acquisition of knowledge (cognitive skills), and hardly any

other skills. A good understanding of Bloom's Taxonomy would drive teaching and learning to impact other very important skills, such as critical thinking skills, problem-solving, experiential learning and interpersonal relationship among others.

3. 5. Exploring bloom's digital taxonomy in the classroom

It is important, that teachers create the best experiences for the students and remain relevant, thus, equipping them with skills that will enable them to be marketable and ready for the workplace. The integration of the use of technology into Bloom's Taxonomy creates what is now known as Bloom's Digital Taxonomy. The purpose of Bloom's Digital Taxonomy is to help educators use technology and digital tools to facilitate student learning experiences and outcomes (**Fig. 2**).

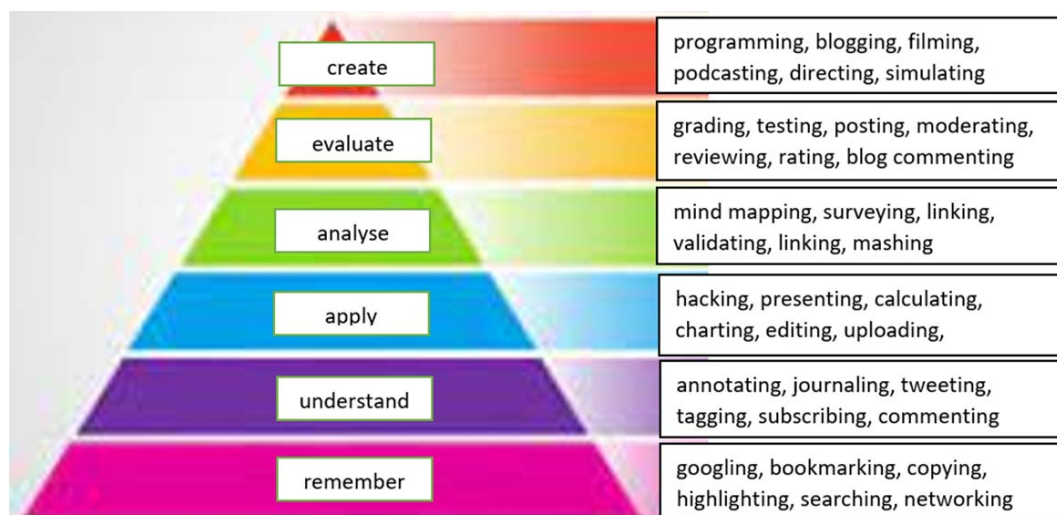


Fig. 2. Bloom's Digital Taxonomy activities. Adapted from [18]

Creating

Canva design. Create online interactive posters

Video editing. Create and share online video lessons and explanations

YouTube: Upload, edit and share videos

Story creation

Show me

Whiteboard

Evaluating

Voice thread: Good tools for online discussions

Protagonize: publish and collaborate online

Google Docs: Create, edit, share, and collaborate on online docs, forms, drawings and spreadsheets

Google Classroom

Edmodo

Zoom

Good drive

And canva design

Analyzing

Mindomo: create and share online mind maps

Poll Everywhere: Create and share polls/ surveys to collect information

Collaborative Classroom: Online classroom discussions

Vokiet avatars do the talking for you

Story bird: Write online stories
Google map
Google slide
Simple mind

3. 5. Why bloom's digital taxonomy should be integrated

The integration of technology into classrooms is always praised and teachers are encouraged to integrate it into their lessons. However, it is not always the case; some teachers still do not. There are many reasons for the teachers to appear resisting. Some teachers are digital immigrants [19], also known as BBTs (born before technology), they, therefore, fear being a laughingstock in class, since the younger generation is born into technology and it surrounds most of their lives like the internet, television, computers, emails etc. People are classified according to the time they were born when it comes to technology. [19] describes the classes of people as baby boomers (1940–1959), generation X (1960–1979), generation Y (1980–2000) and generation Z (after 2000). Prensky further groups them according to their levels of exposure to technology at an early age; he states that baby boomers and generation Y people are digital immigrants (born before the widespread adoption of digital technology), while generation Y are digital natives (born after the widespread adoption of digital technology). The older generation was exposed to digital technologies later in life, while the younger one is born into them. The older generation is still in schools, teaching the younger ones. It, therefore, becomes very important that they are aware of the era they are teaching in and the kind of students they are teaching, since they are very different from them. They must provide them with an education that is relevant to the times they live in.

Times have changed, and so have people and technology. Technology keeps advancing and so should the people; [19] calls this 'singularity'. It, therefore, becomes important that the graduates produced are ready for the workplace and meet the requirements of the job market. It remains the responsibility of the teachers to equip students with all the skills they require to survive in the job market. It is essential now more than before, that student is equipped with digital skills as well as 21st-century skills, identified as critical and creative thinking, problem-solving and communication ones.

Digital Natives think differently. Unlike digital immigrants, digital natives are more comfortable with new technologies and are less scared of making mistakes [20]. This change in the new generations calls for a change in the way they are taught so that learning takes place. Teachers cannot stick to the old ways of teaching when teaching the new generation because digital natives learn and communicate in a different way than digital immigrants. Digital natives have a shorter attention span than the traditional way of learning.

Bloom's Digital Taxonomy encourages interaction and creates motivation. Generally, children learn better when they have an interest in something. If they are not engaged in the activity, they can easily get bored and lose interest, and not learn as a result. Deep learning is what Benjamin Bloom intended with his taxonomy, and what the Education Department and parents envisage from the students. Making the students interested in the lesson makes even the job of the teacher easy, they get to learn the high-order skills, fostered through the top three levels of Bloom's Digital Taxonomy.

3. 6. How to bloom's digital taxonomy can be integrated

Teachers must find ways to incorporate different teaching strategies to ensure that they cater for the kind of students they are teaching. However, this does not mean that they abandon traditional teaching strategies. The best way would be to use both traditional and modern teaching strategies to produce students who are ready to take on the world. Traditional teaching strategies are more on passive involvement of students, while modern learning strategies call for the involvement of students in the lesson. For the effective use of Bloom's digital taxonomy, active learning strategies must be used; teachers must involve in student teaching. Since the younger generation has a short attention span, they will get bored of being passive in the classroom, which could result in the lesson being ineffective. Involving learners actively in the lesson has benefits, they learn to

take responsibility for their learning, they get a deeper understanding of the lesson, and their reading, writing and thinking skills are developed (...). [21] developed the Cone of Learning, which shows that students can remember 70–90 % of what was learnt if they were actively involved in the lesson. Furthermore, [22] states that active participation in the classroom is enjoyed by the students compared to passive. The active involvement of students does not only accommodate the digital natives, but it is also true since students assimilate and process information differently. The VARK model classifies students as visual, aural, read/write and kinesthetic [23]. This model supports the involvement of students when teaching and knowing their needs, so that the teacher is in a better position of assisting them.

Benefits of adopting bloom's digital taxonomy in education:

- restructuring of teaching approaches to make it in form of learners centred approach;
- it encourages immediate feedback;
- it inspires the learners the possibility to actively participate;
- improves digital competency;
- makes learning fun (gamification);
- increases engagement.

3. 7. How schools can support the use of bloom's digital technology

The provision of gadgets and connectivity – Schools need to invest in the provision of gadgets for teachers and learners. Gadgets can be in the form of laptops and tablets. However, the South African President, Mr Cyril Ramaphosa in his state of the nation address announced that every South African learner will get a tablet [24]. The Minister of Basic Education, Mrs Angie Motshekga affirmed the president's words and added that the distribution would start in 2020 in multigrade, multiphase and rural schools. According to the plan by the Minister, all learners should have received their tablets by the year 2025. The aim is to enable all learners to access teaching and learning support materials digitally. In the meantime, teachers can work with what they have, allowing students to access computer labs even for non-ICT subjects.

Training-It can be challenging and overwhelming for teachers to learn to use technology, especially those who are less tech-savvy. Training is very important when one introduces something new. As mentioned above, some of the teachers in schools are digital immigrants, but that does not mean that they cannot learn to use technology. Some are even using it even though they started later in their lives. The key is to give them support in the form of training. Digital immigrants need to be trained before they can be able to use digital technology in their classrooms. They need support from the schools and the Department of Education to achieve this. Training can be in the form of workshops. For the workshops to be effective, they must be ongoing so that if the teachers encounter challenges, they have people assisting them. This can help them feel at ease with the use of technology.

3. 8. Limitation and suggestions for further study

This study is only limited to a systematic review of secondary data from existing pieces of literature. Hence, further study in this regard is suggested through an intervention using digital tools adopting Bloom's Digital Taxonomy using a quantitative method, which can be used to test the students' attitude, academic performance and achievement. Also, further study can explore the use of experimental research by having experiments and control groups.

4. Conclusion

For professional educators to achieve the best results and add value for the learners, there is a need to follow the application of Bloom's Taxonomy and incorporate = technology, following the above application will get students closer to achieving their learning goals. Teachers need support to prevent resentment and innovation fatigue. With this taxonomy well practised in classrooms, teachers can rest assured that the students they produce will make a difference in this world through the skills they have accumulated during their schooling years.

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