# REMODELLING BLOOM'S DIGITAL TAXONOMY TO ENHANCE ITS FEASIBILITY IN SCIENCE INSTRUCTION

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***Abstract:*** Educational taxonomies offer a framework of classifications to organize educational goals and distinguish the appropriateness of particular learning outcomes in a simple and sensible manner within the classroom. Numerous unique educational taxonomies have developed with the objective of stretching the teacher-pupil interaction beyond the four walls of the classroom. This paper is an outcome of the profound examination and analysis of the major educational taxonomies framed and developed by prominent educators. Among the major educational taxonomies, the 'Bloom's Digital Taxonomy' developed by Andrew Churches in 2007, which is an enhanced version of the Revised Bloom's Taxonomy to be more inclusive of digital media, was comprehensively studied, and an infographics on the Bloom's Digital Taxonomy was designed. The investigator framed the phases and constructed lesson templates based on these phases, for each of the major educational taxonomies, including Bloom's Digital Taxonomy, so as to make them well suited for classroom instruction. Also, the practical difficulties in the implementation of the Bloom's Digital Taxonomy in actual classroom situations were identified through a Frequently Asked Question (FAQ) Generation Session.

***Keywords:*** Educational Objectives, Educational Taxonomy, Bloom's Digital Taxonomy, Digital Media, Lesson Template, Infographics, Frequently Asked Question (FAQ) Generation Session.

## I. INTRODUCTION

Abundant discrete educational taxonomies, developed by distinguished educationalists are available. Among them, Bloom's taxonomy has created a remarkable impact in the entire educational practices. But Bloom's Taxonomy had often been misemployed and misjudged by educators. It failed to acknowledge that learners might perform at varying levels of proficiency within each type of higher order thinking skill. In practical contexts, it gave emphasis to the attainment of the cognitive domain objectives alone. Ample educational taxonomies evolved subsequent to Bloom's taxonomy with the intention of thrusting the classroom instruction beyond rote learning. Each one of these was exceptional with respect to the remarkable features. They provide a transparent depiction of the fashioning of the classroom instruction to gratify the requisites of the existent generation. Also, each of these taxonomies possesses a significant and solid theoretical background. The timeline of the various taxonomies of educational objectives is shown in Figure 1.

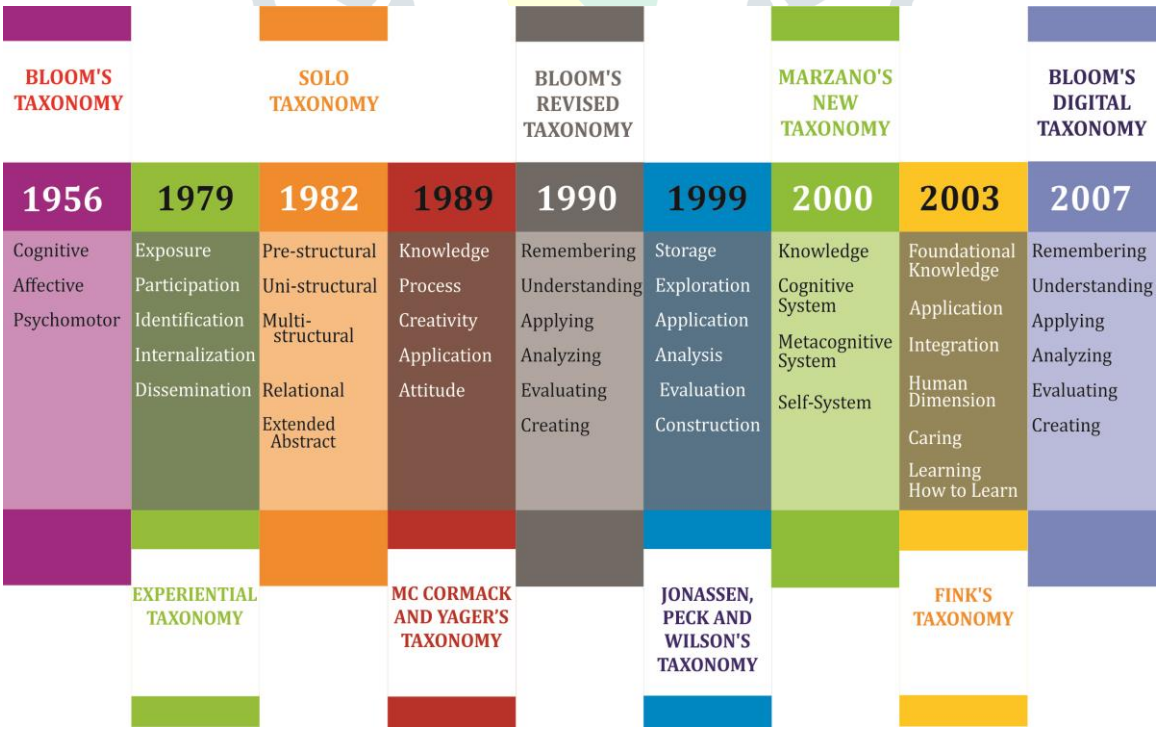


Figure 1: Timeline of Major Educational Taxonomies

## BLOOM'S DIGITAL TAXONOMY (2007)

The society has witnessed striking changes over the last few decades. During this period, the Revised Bloom's Taxonomy had supported as a powerful tool to fit the needs of the teachers. The conceptualization of the Revised Taxonomy Table matrix offers a well-defined pictorial depiction of the configuration between benchmarks and educational goals, objectives, products, and behaviours. Today's teachers must make stern resolutions on how to utilize their time within the classroom. Sharp arrangement of educational objectives with native, state, and nationwide standards is necessary. The whole thing must suit properly like the pieces of a giant puzzle. The Revised Bloom's Taxonomy Table explains clearly how each lesson template fits to its goal or objective, essential question and purposefulness.

Educators have a foundation by which to associate digital practices to the more traditional benchmark created by Bloom, using some great design by Andrew Churches. Mr. Churches believes in preparing students for a change, teaching them to think and to question, and also to modify and adapt, thereby preparing the for the future. Andrew Churches enhanced Revised Bloom's taxonomy to be more comprehensive of digital media, thus creating Bloom's Digital Taxonomy in 2007. Bloom's Digital Taxonomy is a refined adaptation of Revised Bloom's Taxonomy to comprise the new actions, behaviours and learning prospects arising as technology progresses and becomes more universal. Even though there are clear demarcations in many features, his work offers a significant background from which educators can deal with a subject. The biography of Andrew Churches is shown in Figure 2.


Figure 2: Biography of Andrew Churches

The six categories in Bloom's Digital Taxonomy are described below:

a) **Remembering**: For the first part in the Revised Bloom's Taxonomy namely Remembering, the emphasis is on retrieval of knowledge. Under the traditional Bloom's theory, we have made use of phrases as recognizing, listing, describing, naming and locating. Churches specifies that as we proceed to the digital world, it is desirable to use phrases like bulleting to spot key words or phrases for recall. Similarly, students may bookmark or favorite a web page or site for later use. Still another characteristic for this basic step in the taxonomy would be the social networking area in which there are crucial relationships between people. The online form of local bookmarking or favorites namely Social bookmarking is suitable and probably a little more superior because users could draw on the bookmarks of others. Finally, educators should pay attention that Churches views the most common task, that of searching or 'Googling' as another remembering concept so long as the search does not step outside the fundamental key term or word. The instructional strategies related to this domain are illustration, narration, imagery, demonstration, modeling, and drill and practice.

b) **Understanding**: Here the customary taxonomy phrases get converted into interpreting, summarizing, inferring, paraphrasing, comparing, and explaining. In the modern digital world, Churches foresees the movement towards perfecting basic search techniques as a move along the track of understanding. Another significant aspect is Blog journaling provided that the emphasis was on merely talking, writing, or typing a task-based item. Twittering is another instance by responding to the fundamental question, "What are you doing?" Churches summarizes that if Twittering and Journaling are used to cultivate better understanding or if they are used to team up with colleagues, they can undoubtedly surpass the understanding level to higher levels of the taxonomy. Churches notes down two other digital spaces suiting the understanding level as that of categorizing and annotating or commenting files. The digital organizing and classifying of files obviously establish a level of understanding while commenting and annotating web pages is likely equivalent to taking notes. The instructional strategies connected to this domain are demonstration, role-playing, simulation, illustration, imagery, modeling, case study, and drill and practice.

c) **Applying**: When we move up the Bloom's taxonomy, the subsequent level is indicated as applying. In the traditional Bloom's taxonomy, we deal with execution, utilizing information and performing tasks. Here Churches recommends numerous examples of students' doing. For instance, students may commence a program or/and operate and manipulate applications and hardware. In Gaming technology, when students establish both understanding of the process and the skill set, then they are applying these to the game task. Applying would also include the uploading and appropriate sharing of materials on sites like Flickr. Churches also introduces editing skills and links them with the understanding of tasks like Twittering or/and journaling. Finally, Churches puts clear-cut hacking, defining as 'applying a simple set of rules to achieve a goal or objective', too in the application level. The instructional strategies connected to this domain are demonstration, role- playing, modeling, case study, simulation, illustration and imagery.

d) **Analyzing**: As we proceed even further into the Higher Order Thinking Skills, we reach analyzing of the learned things. The digital counterparts for the phrases like comparing, organizing, structuring and integrating, in the original Bloom's taxonomy comprise of mash ups where several data sources are merged into a single set of usable information. Churches also puts the appropriate establishment of links within documents and web pages in the analyzing set. At this stage, Churches denotes that though students can access a wide variety of data, much of it may be short of authenticity. Therefore the students need to be able to validate their information. Though this feature seems to involve both analysis and making judgments, Churches positions it in the analyzing category. Churches also records tagging the organizing, structuring and attributing online data, meta-tagging web pages, etc. Definitely the students should be capable of understanding the materials in order to be able to accomplish this step although there is some observable overlay with the previous applying level. Besides this, Churches places the reverse- engineering (possibly positive) and cracking (not likely positive) behaviors in this category. The instructional strategies associated with this domain are discussion, illustration, modeling, brainstorming and case study.

e) **Evaluating**: The fifth level of evaluating refers to hypothesizing, critiquing, experimenting, judging, testing and monitoring in the traditional Bloom's taxonomy. At this stage, the students begin to site informed judgments to lead towards new ideas. Churches judges blog commenting and reflecting as simple instances of this aspect where students comment and reply to other postings. Fundamentally, students inspecting information in context and then replying must include some form of evaluation. For these comments, there need to be a posting of a suitable, thorough, reflective response by one person and the prospective evaluation or equability of those posts by another person, which includes two very important diverse applications. In the collaboration and networking aspect, Churches fairly reports that for collaboration to be effective, the strengths and abilities of the participants as well as their contributions have to be evaluated. This level also involves the testing of an application or product. For anybody to test a process or tool efficiently, the tester must have the capacity to analyze the purposefulness of the tool or process. This requires not only the knowledge of what the exact function should incorporate, but also what it demands in the mean time. The instructional strategies linked to this domain are brainstorming, case study, guided discussion and role-playing.

f) **Creating**: At the highest level of the taxonomy, the students are found to be creating. Here the emphasis is on designing, inventing, constructing, planning and producing. This anticipation makes us easy to understand the reason why more and more people place greater prominence on creativity within the school setting. It is at this level that we would locate technology mixing greatly with the creative process. It could include audio and video and originate in the form of a film, an animation, a podcast or a videocast. This domain shows an intense amount of mixing and remixing to eventually produce unique products. Finally, there is publishing of some type here, so anything associated to a written or video blog, even a Wiki would relate. Churches also suggests supplementary digital equivalents at this step of the taxonomy as the development of a game or the creation of a program application. The instructional strategies linked to this domain are simulation, modeling, illustration and role-playing.

## II. STATEMENT OF THE PROBLEM

'Remodelling Bloom's Digital Taxonomy to Enhance its Feasibility in Science Instruction'

## III. OBJECTIVES OF THE STUDY

1) To create and develop a fundamental structure in the form of phases for the Bloom's Digital Taxonomy, so as to make it compatible for classroom instruction.
2) To create an infographics based on Bloom's Digital Taxonomy.
3) To develop a lesson template on the Bloom's Digital Taxonomy, based on the phases developed.

## IV. METHODOLOGY

The concept of Bloom's Digital Taxonomy has been theorized since 2007. But the practical application of this concept in actual classroom situations it rarely tracked. Through this study, the investigator attempts to create and develop a fundamental structure for the Bloom's Digital Taxonomy in the form of phases, which facilitates its implementation in the real classroom settings. Also, an infographics based on Bloom's Digital Taxonomy is created. Besides this, a sample lesson template on the Bloom's Digital Taxonomy is constructed to illustrate the model, on the topic 'Food Chains and Webs' from Science.

### 4.1. CONSTRUCTION OF PHASES FOR BLOOM'S DIGITAL TAXONOMY

The phases constructed by the investigator for the Bloom's Digital Taxonomy of educational objectives are described below:

***Phase 1: Data Mining***

The teacher presents a contemporary issue to the students through a brainstorming session. The teacher divides the students into small task groups. By providing relevant websites, he/ she asks the students to explore the issue, list the relevant ideas into files and name them.

***Phase 2: Digital Organization***

The teacher asks the students to digitally organize and classify the files related to the issue using folders or other tools. The students tag web pages to the files, if necessary, for which they need to be able understand the content of the pages.

***Phase 3: Uploading***

The teacher asks the students to create a blog on the issue and to edit, upload and appropriately share the organized files into the blog. Here, the students develop content through rephrasing and authoring materials by editing them to a suitable standard in a wiki environment or blog. This is a stage where the students go through active collaboration.

***Phase 4: Integration***

The teacher asks the students to blend several sources of data into a single set of usable information. Here, the students establish links within documents and web pages and, tag and validate their information.

***Phase 5: Opinion Generation***

The teacher asks the students to post the accumulated information into the blog created, and comment and reply to others' postings. Commenting involves the posting of an appropriate, thoughtful, in depth response by one group of students, and replying involves the potential evaluation or moderation of those posts by other groups.

***Phase 6: E- Publishing***

The teacher asks the students to mix and remix audio or video or both so as to ultimately produce unique products in the form of a film, animation or video based on the issue. The students then publish it in a written or video blog or Wiki. This requires a huge overview of not only the content being published, but also the process and product.

### 4.2. INFOGRAPHICS CREATION ON BLOOM'S DIGITAL TAXONOMY

The infographics of the Bloom's Digital Taxonomy created by the investigator is shown in Figure 3.

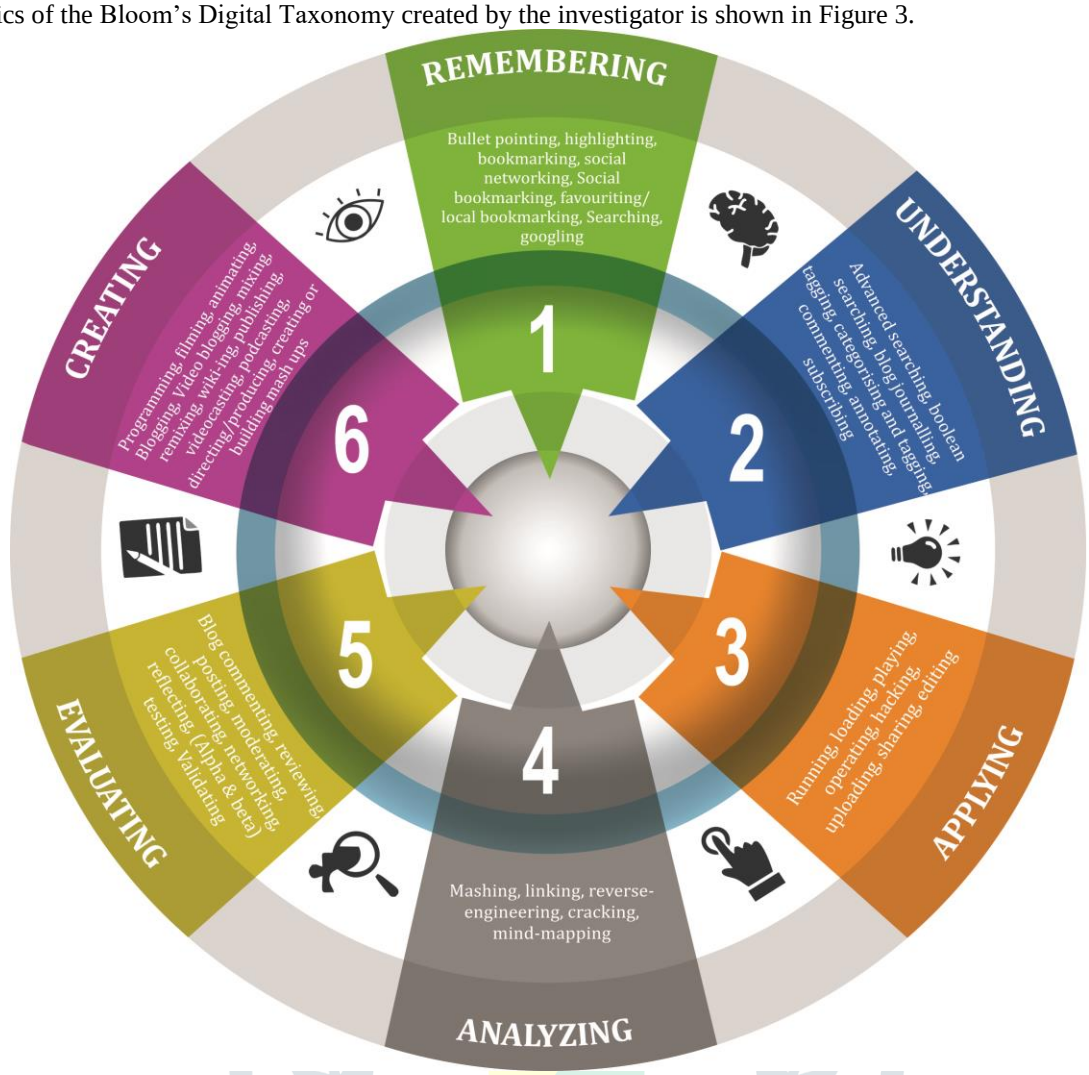


Figure 3: Bloom's Digital Taxonomy

### 4.3. LESSON TEMPLATE CREATION ON FINK'S TAXONOMY

A sample lesson template on the Bloom's Digital Taxonomy is constructed on the topic 'Food Chains and Webs' in Science, based on the phases developed. This is attached as APPENDIX.

### 4.4. IMPLEMENTATION OF THE FREQUENTLY ASKED QUESTION (FAQ) GENERATION SESSION

A Frequently Asked Question (FAQ) Generation Session was conducted to identify the practical difficulties in the implementation of the existing major educational taxonomies. The meeting intended to generate awareness about different educational taxonomies among the student- teachers and to elicit maximum doubts in the form of Frequently Asked Questions (FAQs). It was conducted among the student- teachers of Department of Teacher Education, Government College of Teacher Education and Mar Theophilus Training College.

The difficulties identified in the implementation of the Bloom's Digital Taxonomy were as follows:

- Less provision for the global sharing of ideas
- Unsuitability for language lessons
- Lack of time
- Lack of proper assessment of the e- content published
- Masking the role of teachers in the classroom
- Encouragement of plagiarism of ideas from the internet
- Lack of reinforcement for low achieving students
- Less emphasis to psychological concepts
- Limited role of teacher

## V. FINDINGS AND DISCUSSION

The taxonomy devised by Andrew Churches gives educators an excellent framework from which to begin to assess their digital practices. We identify that several teachers are inclined to push the concept of 'search', especially search alterations, beyond the taxonomy levels. But at the same time, the digital examples provided by Churches at the evaluation stage deliver strong strengthening for the use of blogs and Wikis to deeply augment learning. Teachers seeking a more comprehensive look at Churches' thoughts consult the Bloom's Digital Taxonomy. Andrew Churches envisaged the foreseeable changes on teaching styles to adapt to our environment in this digital world. It would be extremely advantageous for the teachers to devise new teaching strategies that would help their students become accustomed to the fast developments in technology. Thus in order to groom students for the future, teachers must train them for a change.

## VI. CONCLUSION

Online resources can save our precious time and money while lowering the chaos in the classroom. These options use technology to help us diminish the amount of paper products bought, printed and photocopied. Instead of printing hand-outs, we can use email to send documents home to parents with Internet access. Also, a classroom website could be created to post homework assignments, supplemental materials and announcements. By creating a blog, the parents and students could be notified of classroom activities. Thus, the structure of learning could be changed so that soft copies replace hard copies completely. This throws light into the scope of using digital tools and paper- free classroom practices. The span of the application of digital tools in education has to be reflected in the taxonomy revision, which should in turn be mirrored in the curriculum framework. Thus the implementation of the Bloom's Digital Taxonomy in the proper manner could inventively be capable of preparing students for the future lives. Since the current theoretical compulsions bring about significant changes in the students' needs, they need to develop their knowledge and skill through need- based learning opportunities. Subsequently, the taxonomies used today need an advancement and modernization. As years pass by, the classroom picture changes still more, along with the students' needs. In this context, it is obligatory to refashion and upgrade the existing taxonomies.

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## APPENDIX

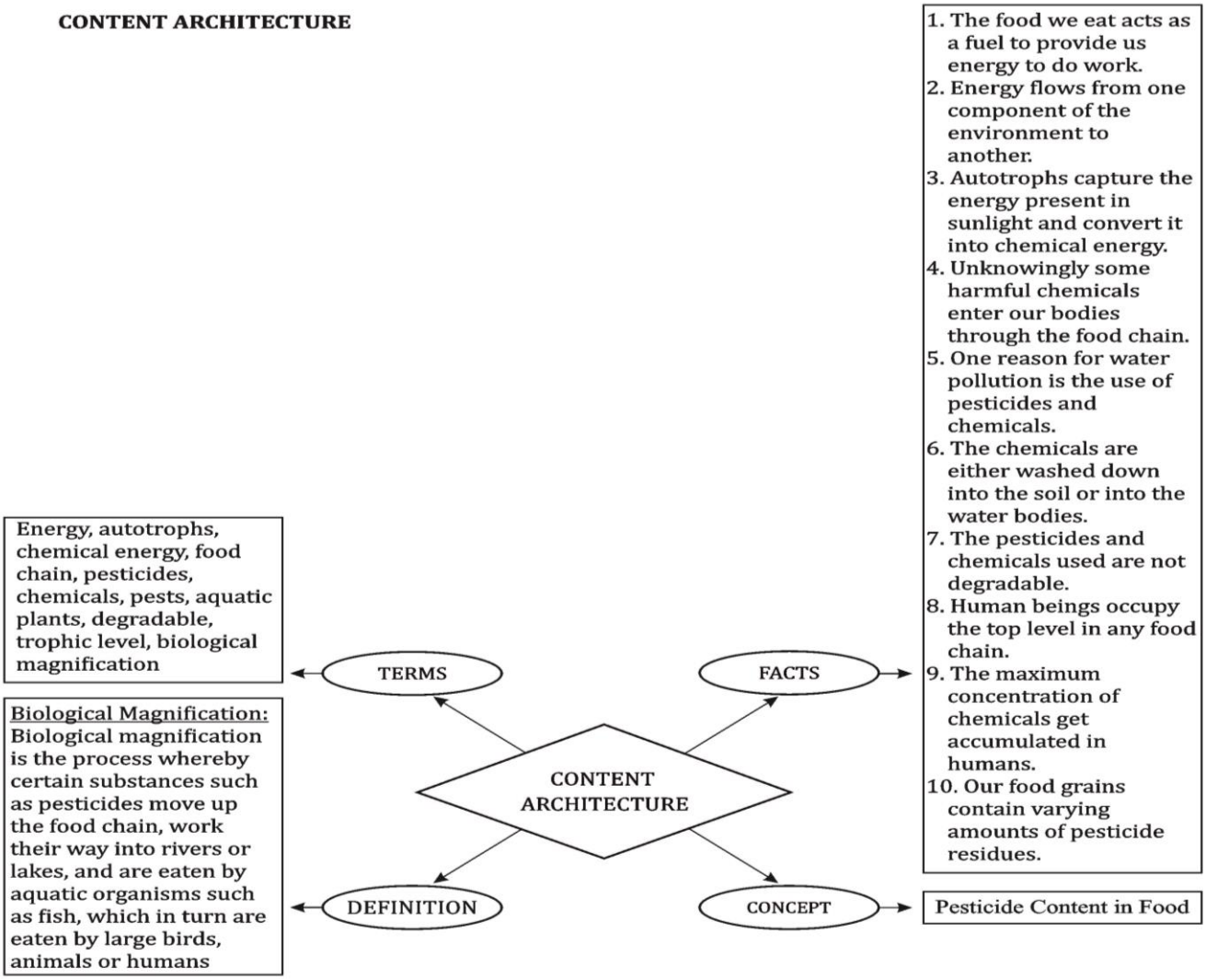
# BLOOM'S DIGITAL TAXONOMY
(2007, Andrew Churches)

| | | | |
|---|---|---|---|
| Name of Teacher | : | Name of School | : |
| Subject | : Science | Standard & Division | : X |
| Unit | : Our Environment | Duration | : |
| Subunit | : Food Chains and Webs | Date | : |

**STATEMENT OF CURRICULAR APPROACH**

Through pupil centered, activity oriented, technology integrated approach, the students achieve higher order thinking skills through the learning of food chains and webs.

**CONTENT ARCHITECTURE**



**LEARNING OBJECTIVES**

| 21st Century Skills → / Phases ↓ | Critical Thinking | Communication | Collaboration | Creativity | Problem Solving | Innovation |
|---|---|---|---|---|---|---|
| Data Mining | | | | | | |
| Digital Organization | | | | | | |
| Uploading | | | | | | |
| Interaction | | | | | | |
| Opinion Generation | | | | | | |
| Publishing | | | | | | |

(Note: The learning objectives are represented in the form of a grid with the phases of the Bloom's Digital taxonomy along the vertical axis and 21st century skills along the horizontal axis.
The 21st century skills are given in the following reference:
http://www.p21.org/storage/documents/21st_century_skills_education_and_competitiveness_guide.pdf)

**SUPPORTING RESOURCES**
Computer with Internet connection

**SPECIFIC PROCESS SKILLS TO BE ATTAINED**
Observing, communicating, inferring, predicting, formulating hypotheses

**DIGITAL PRACTICES UTILIZED**
Googling, Categorizing, Uploading, Mashing, Posting, Commenting, Publishing

**SUGGESTED ARTIFACT TO BE EVOLVED**
An infographics on the pesticide content in food items, a video or an audio on an interview with an organic farmer, or a podcast based on the issue

**PRE REQUISITES**
The students already know about food chain, the different trophic levels, autotrophs, primary, secondary and tertiary consumers.

*Set Induction, Meaningful Verbal Learning, Multi- sensory Approach, Guided Discovery Learning, Co- operative Learning, Learning by Doing*

| *Phases Involved and Procedural Details* | *Expected Pupils' Response* |
|---|---|
| **Phase 1: Data Mining**<br>The teacher introduces the discussion forum of the school to the students and informs them about the thread created by him/ her within the forum labeled as ' ban of food items', and about the sub-threads labeled 'causes for bans', 'sources of pesticides', 'methods to reduce pesticide content in food'. The teacher asks the students to use their own personal devices as a part of BYOD (Bring Your Own Device) for exploration. | The students become aware of the discussion forum, the thread and the sub-threads created by the teacher. The students express their enthusiasm to use their own personal devices for exploration. |
| The teacher divides the students into three task groups and asks the students of each group to individually explore on the 'causes for bans', 'sources of pesticides', 'methods to reduce pesticide content in food' respectively. The teacher also directs the students to post the documents made to the respective sub-threads. | The students work in three groups to explore on the 'causes for bans', 'sources of pesticides', 'methods to reduce pesticide content in food' respectively. Within each group, the students work individually and post the documents made to the respective sub- threads. |

| | *Phases Involved and Procedural Details* | *Expected Pupils' Response* |
|---|---|---|
| *Co- operative Learning, Multi-sensory approach, Constructivism* | **Phase 2: Digital Organization**<br>The teacher selects a leader from each task group and asks them to do intra-group organizing, that is, to organize the documents prepared by the members of their respective groups into a single output, by ensuring the active participation of the group members. | The leader from each task group organizes the documents prepared by the members of their respective groups into a single output. |
| *Multi- sensory approach, Guided Discovery Learning, Learning by Doing* | ***Phase 3*: Uploading**<br>The teacher asks the task group leaders to upload the organized document into the discussion forum in the sub- threads labeled 'causes for bans', 'sources of pesticides', 'methods to reduce pesticide content in food' respectively. The teacher, who is the moderator of the forum, archives the sub- threads created earlier for future references. | The task group leaders upload the organized document into the discussion forum in the respective sub- threads. |
| *Guided Discovery Learning* | ***Phase 4*: Integration**<br>The teacher blends the content of the different sub- threads into a single set of usable information, labels it as 'pesticide content in food items' and posts it to the discussion forum. | The students observe carefully the blending of content into a single data and the posting of it to the discussion forum. |

| | *Phases Involved and Procedural Details* | *Expected Pupils' Response* |
|---|---|---|
| *Constructivism, Multi- sensory Approach* | ***Phase 5:* Opinion Generation**<br>The teacher asks the students to use their own personal devices to comment and reply to others' opinions or postings. | The students comment and reply to others' postings using their own devices. |
| *Induced Thinking Principle, Creative Construction of Knowledge, Learning by Doing* | ***Phase 6*: E- Publishing**<br>The teacher gives follow- up activities to the students to create an infographics on the pesticide content in food items, a video or an audio on an interview with an organic farmer, or a podcast based on the issue and publish it into the discussion forum. | The students create an infographics on the pesticide content in food items, a video or an audio on an interview with an organic farmer, or a podcast based on the issue, and publish it into the discussion forum. |

**CLASSROOM EXTENSION**

Now- a- days, meat is found to contain varying amounts of pesticide residues, which cannot always be removed by washing or other means. Analyze.