

Cognitive and Meta-Cognitive 3D Digital Skills Needed for Lifelong Modeling Techniques in Blender by Computer Science in State University of Medical and Applied Science, Igbo-Eno and Madonna University, Okija

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Abstract

The study sought to determine the Cognitive and Meta-Cognitive 3D Digital skills needed for lifelong modeling techniques in Blender by undergraduates of Computer Science in State University of Medical and Applied Science, Igbo-Eno, and Madonna University, Okija. Population of 150 undergraduates of Computer Science students was used. Taro Yamane's statistical sampling method was used to determine sample size of 100 respondents. Purposive sampling technique was adopted for the study. The instrument used for the study was titled Cognitive and Meta-cognitive 3D Lifelong Modeling Techniques with Blender (CM3DLMTB). Online survey form was used for distribution and collection of data. Two research questions were answered by the study. Cronbach alpha technique was used in testing the item reliability co-efficient and cluster value of 0.85 was obtained. The instrument was administered to the respondents through their social media handles. The response option of the questionnaire was structured on a 5-point Likert rating scale with weighted points of 5, 4, 3, 2 and 1 respectively. The instrument was face validated by 3 experts in IT and 3D graphic design. A bench mark of 3.0 was used as the agreement or disagreement level. Scores greater than or equal to the bench mark were marked as Needed while scores less than the bench mark were remarked as Not needed. Weighted mean was used in taking decision on the item statements and it was interpreted in relation to the cut-off mark of the response option used for decision making. Standard deviation (SD) was also used to determine the closeness or otherwise of the responses of the respondents to the mean. Any item with a low SD shows that individual responses were close to the mean while high SD shows that the responses are at the either extreme.

Keywords: 3D Modeling Skills, Lifelong 3D skills, Cognitive Skills, Meta-Cognitive Skills, 3D Skills for Blender

Introduction

The existence and survival of any individual depends on the plethora of skills the individual possessed to navigate life challenges. This is tantamount to the tools available to the individual for the day-to-day problems solving. Life is filled with problems or challenges depending on the mental disposition of the individual. Knowing and possessing requisite skills are just part of the requirements to solving

problems but more importantly is the effectiveness in the application of the skills using appropriate tools. Organization for Economic Cooperation and Development (OECD, 2019) enthused that skills are part of the holistic concept of competency, involving the mobilization of knowledge, skills, attitude and values to meet complex demands. Skill is the ability to perform an action with determined results

often within a given amount of time, energy, or both (Salmela, 2009).

One of the actions which skill is needed for is modeling. Ansorge and Skender (2012) explain model as a complete description of a system from a particular perspective or simplification of reality. A model can also be seen as an abstraction of reality. Modeling is done to achieve four aims, namely visualization of a system, specification of the structure or behaviour of a system, setting of templates that guide the construction of the system and documentation of the decisions made (Pericheria, 2023). Modeling tools needed in graphics or animation are guided by mathematical principle like geometry which deals with placement of coordinates in space, lines, shapes and figures in different dimension. These properties of geometry are interpolated to graphical shapes with human characteristics thus, transforming to 3D animation models.

Three-dimensional (3D) modeling is the process of developing a mathematical coordinates-based representation of any surface of an object (inanimate or living) in three dimensional planes via specialized software by manipulating edges, vertices and points (Slimislime, 2023). The author adduced that, 3D represents a physical body using a collection of points in 3D space, connected by various geometric entities such as triangles, lines, curved surfaces and so on. These bodies are grouped as mesh and are built with vertices, edges and faces. 3D models are made with computer-based 3D modeling software like Blender (FutureLearn, 2022).

Blender is a robust open-source tool used primarily for 3D modeling, animation, and rendering (Taylor, 2023). Blender is a game development freeware program maintained by the Blender Foundation

(Chronister, 2011). The author acknowledged that Blender can be a difficult program to learn with limitless possibilities and that any rendering and animation program has a tough learning curve. Hence, Chronister (2011) maintained that one needs lifelong learning attitude to acquire the skills needed to operate Blender software in order to access all the limitless creative and innovative possibilities that are inherent in Blender. Blender has a vast array of editors and modes which requires skills to master them. The editors in Blender are seven (7) in number which are: 3D view, Logic Editor, Node Editor, Text Editor, Movie Clip Editor, Video Sequence Editor and UV/Image Editor while the modes are object interaction modes which comprises 3 Modes and 3 Paints. The three modes are: Object Mode, Edit Mode, Sculpt Mode while the other three supplementary Paint modes are: Vertex Paint, Weight Paint and Texture Paint. Blender has so many tools that require skills for manipulation of Vertex, Edge and Face in Blender objects.

Skills needed for Blender 3-dimensional software are connected to 21st century skills (Mahmud & Wong, 2022). The authors enumerated the 21st century skills to be, thinking which includes: creativity and innovation, critical thinking, problem solving, decision making, learning to learn; working with others which includes: communication, collaboration/teamwork; facility with tools which includes: information literacy, communication technology literacy, and general life skills which encompasses: citizenship, life and career management, personal and social responsibility, cultural awareness. These skills are captured in Bloom's taxonomy which espoused three different types of skills in its learning domain. These domains according to

(Hoque, 2023) are cognitive domain (knowledge-based), affective domain (emotion-based) and the psychomotor domain (action based). Taurez (2022) states that cognitive is related to the process of acquiring knowledge (cognition) through the information received from the environment, while metacognition refers to the ability of people to reflect on their thought processes and the way they learn. Metacognition is often defined as thinking about thinking, while cognitive processes allow normal functioning of individuals (Dawson, Ragel, Daniel, Kahanda, Kris, & Dilip, 2018). The authors explained that meta-cognition takes cognition a level higher by making a person more aware of their cognitive processes. Cognition needs to be sharpened with constant usage of meta-cognitive skills so that, the cognitive skill will continually be in good condition. In corroboration, Flexman (2021) emphasized that cognitive decline is reduced by those who engaged in lifelong activities.

Lifelong skills are interpersonal, cognitive or behaviours to help one succeed in life (Indeed, 2022). It falls into three broad areas under emotional skills: ability to manage one's feelings effectively and understand oneself, thinking skills: thinking of solutions to a problem or developing new solutions creatively and social skills: learning to communicate effectively, interact with others and develop healthy relationships. Some specific examples of lifelong skills according to Indeed (2022) are problem-solving, communication, critical thinking, self-awareness, decision making, resilience, empathy, team work and time management. These skills are lifelong because their acquisition is not time bound. Lifelong learning according to Deepak and Prakash, (2023) is an unending process that includes formal, non-formal, and informal

ways to improve knowledge, skills, and competences. It promotes skills acquisition beyond the traditional school and throughout life. Undergraduates' students who are learning in schools need skills that will sustain them outside the school and possibly throughout their life.

Undergraduates according to Lawinsider (n.d.) are individuals who are enrolled in a postsecondary educational program, which leads to or is directly creditable towards the individuals' first degree. There are different courses of study by undergraduates in which Computer Science is prominent among them.

Computer science is the study of computers and computational systems (Michigan Technological University MTU, 2023). Furthermore, MTU (2023) clarified that it is a broad field which includes everything from the algorithms that make up software to how software interacts with hardware to how well software is developed and designed. Again, it provides solutions to the complex challenging problems of all kinds. This challenging problem here needs a high proficiency skill level in using software like Blender to tackle them. Three dimensional related problems are purely an example of these challenging problems that needs skills for lifelong learning. Unfortunately, the levels of lifelong skills possessed by undergraduates of Computer Science have not surpassed that of the basic ICT skills. This low level of skills possessed by undergraduates is the reflection of the skills possessed by the students' lecturers. Nwangwu and Obi (2014) in Anyim (2019) observed that Computer Science lecturers are less competent in major components of animation creation. This observation is a strong reflection on the competence of the students in animation. Moreover, some students who are interested in learning of

animation tend to be discouraged because of so many factors. Prominent among them is the timeframe it takes to learn animation in Blender. In affirmation, Miyatovich (2022) succinctly stated that it takes time to master Blender. One can extrapolate that the students lack the patience which (Hales, n.d.) opined is one of the attributes needed for meta-cognitive lifelong skill in Blender competency. Hence, the need for this study which generally seeks to determine effective cognitive and meta-cognitive 3D digital skills needed for lifelong modeling techniques in Blender by undergraduates of Computer Science in State University of Medical and Applied Science, Igbo-Eno and Madonna University, Okija. The specific objective seeks to determine: Effective Cognitive and Meta-cognitive skills required for lifelong studying with Blender software. While the research question seeks to answer: how cognitive and meta-cognitive skills affect lifelong studying of the students in Blender software?

Methodology

Survey research design was adopted for the study and it is best suited for this research because, Surveyplanet (2020) explained that surveys are the most suitable method of research when the researcher wants to draw insight from a specific group within a target audience. The targeted audiences are undergraduates of computer science students in the State University of Medical and Applied Sciences, Igbo-Eno (SUMAS) and Madonna University, Orkija. Specifically, online survey mode was used because it is easy to reach the whole respondents and allows them to respond at their convenient time.

The study was carried out in Computer Science Departments in two different Universities and in two different states in South East of Nigeria. The

population of the Study is 150 respondents which comprises of the students that offer Computer Sciences as a course in the two universities. Taro Yamane statistical model was used to get the sample size of 100 respondents. The technique used in selecting the sample was purposive or judgmental sampling technique. This is because (Kumar, 2011) said that judgmental or purposive sampling is used when the researcher considers who can provide the best information to achieve the objectives of the study. Furthermore, the technique is extremely useful when describing something that is known by only a little number of respondents.

Two research questions were developed to guide the study. Based on that, an online structured questionnaire titled Cognitive and Metacognitive 3D Lifelong Modeling Techniques with Blender (CM3DLMTB) made up of two clusters was designed with Google form and administered to the respondents through their social media (SM) handles to elicit information from the respondents. The electronic instrument was validated by 2 experts in IT and 3D graphic design. Cronbach Alpha technique was used to determine the internal consistency of the instrument and reliability co-efficient of 0.90 and 0.80 were respectively obtained for the two clusters in the instrument and the total reliability co-efficient of 0.85 was obtained. These co-efficient values were considered to be good because Metcalf (2017) affirmed that co-efficient value of 0.80 and above is good. The response options of the instrument were structured on a 5-point Likert rating scaling of Very High Extent (VHE), High Extent (HE), Moderately Extent (ME), Low Extent (LE) and Very Low Extent (VLE) with weighted points of 5, 4, 3, 2 and 1 respectively. The

cut off mark of 3.0 was determined using 5-point Likert scale and it was used as the agreement level. Scores greater than or equal to the cut off mark were remarked as needed while scores less than the cut off mark were remarked as not needed. Inferential statistical tools used are Mean and Standard Deviation (SD). Mean was used in taking decision on the item statements and it was interpreted in relations to the cut-off mark of the response option

Results

The results of the study were obtained from the research questions answered by the respondents. These answered questions are presented in Tables 1 and 2.

Research Question 1: What are the Cognitive and Meta-cognitive skills

Table 1: Cognitive and Meta-cognitive skills required for lifelong learning with Blender software

S/N	Item Statements	\bar{x}	SD	Remarks
1	ability to observe natural environment for new knowledge transfer into Animation environmental scenes	4.00	1.87	Needed
2	Ability to mix colour approximate to real life in Blender	3.40	1.54	Needed
3	Ability to apply lighting approximate to real life in Blender scenes	3.20	1.44	Needed
4	Ability to identify differences in natural environmental phenomenon	4.44	2.14	Needed
5	Ability to identify differences from natural situations	4.00	2.14	Needed
6	Ability to apply imaginative ideas into animation	3.55	1.52	Needed
7	Ability to express ideas with objects	4.00	2.02	Needed
8	Ability to convert ideas into story	3.10	1.39	Needed
9	Ability to express thoughts in numbers and figures	3.78	2.06	Needed
10	Ability to transform ideas into characters	3.10	1.39	Needed
11	Ability to deform Blender objects to new objects	3.78	2.06	Needed
12	Ability to think of innovative ways of placing objects among others	3.78	2.06	Needed
13	Ability to place objects in relation to others to produce new meaning	3.20	1.51	Needed
14	Ability to identify beauty in nature	4.00	1.97	Needed
15	Ability to recreate identified beauty in nature into graphics	3.89	1.96	Needed
16	Ability to animate the recreated identified beauty in graphic	3.77	1.78	Needed
17	Ability to modify characteristics of living thing into novel characters	3.75	2.36	Needed
18	Ability to separate part from a whole	3.89	1.96	Needed
19	Ability to isolate a whole from a part	3.89	1.96	Needed

used. Standard Deviation was used to determine the closeness or otherwise of the responses of the respondents to the Mean. Any item statement with a low SD shows that individual responses were close to the mean while high SD shows that the responses were far from each other. Clustered mean and SD were used to determine the cognitive and meta-cognitive skills required for the students.

required for lifelong learning with Blender software?

The data for answering this research question is presented in frequency distribution format in Table 1.

20	Ability to give suitable meaning to the isolated whole from a part	4.89	2.42	Needed
21	Ability to give suitable meaning to the isolated part from a whole	3.67	1.96	Needed
22	Ability to accommodate different perspective to new ideas	3.89	1.96	Needed
23	Ability to sketch or draw with straight lines to form objects	3.88	2.31	Needed
24	Ability to sketch or draw with curved lines to form objects	3.67	1.89	Needed
25	Ability to interprets written stories with actions	3.67	2.27	Needed
Cluster Summary		3.77	1.88	Needed

\bar{x} = Mean, SD = Standard Deviation

From the result in Table 1, it shows that item statements numbered from 1 to 25 have their means to be above 3.00 bench mark showing that all the item statements are needed for cognitive and meta-cognitive skills required for lifelong studying with Blender software. The Standard Deviation values range from 1.39 to 2.42 which shows that the responses were close to the mean.

Research Question 2: How are the Cognitive and Meta-cognitive skills affects lifelong learning of the students in Blender software?

The data for answering research question 2 is presented in frequency distribution format in Table 2.

Table 2: How Cognitive and Meta-cognitive skills affects lifelong learning with Blender software.

S/N	Item Statements	\bar{x}	SD	Remarks
1	Observation of natural environment for new knowledge transfer into Animation environmental scenes	4.00	2.13	Needed
2	Mixing of colour approximate to real life in Blender	3.78	1.71	Needed
3	Applications of lighting approximate in Blender scenes	3.55	1.71	Needed
4	Identification of differences in natural environmental phenomenon	3.67	1.94	Needed
5	Application of identified difference from natural situation into animation	3.67	1.94	Needed
6	Application of imaginative ideas into animation	3.89	1.96	Needed
7	Expression of ideas with objects	3.56	1.71	Needed
8	Conversion of ideas into story	4.11	2.10	Needed
9	Expression of thoughts in numbers and figures	3.56	1.64	Needed
10	Transformation of ideas into characters	4.11	2.04	Needed
11	Deformation of objects for new objects	3.44	1.43	Needed
12	Thinking of innovative ways of placing objects among others	3.78	1.90	Needed
13	Placement of objects in relation to others to produce new meaning	3.33	1.44	Needed
14	Identification of beauty in nature	3.67	2.07	Needed

15	Recreation of identified beauty in nature into graphics	4.00	1.97	Needed
16	Animating the recreated identified beauty in graphic	3.77	1.78	Needed
17	Modification of the characteristic of living thing to novel characters	3.89	1.96	Needed
18	Separation of part from a whole	3.78	1.69	Needed
19	Isolation of a whole from a part	4.00	2.13	Needed
20	Interpretation or giving of suitable meaning to the isolated whole from a part	3.44	1.57	Needed
21	Giving of suitable meaning to the isolated part from a whole	3.78	2.06	Needed
22	Accommodation of different perspective to new ideas	3.88	2.32	Needed
23	Sketching or drawing in straight lines to form objects	3.77	1.78	Needed
24	By sketching or drawing in curved lines to form objects	3.67	1.95	Needed
25	Interpretations of written stories with actions	4.11	2.10	Needed
Cluster Summary		3.77	1.88	Needed

\bar{x} = Mean, SD = Standard Deviation

From the results in Table 2, it shows that item statements numbered from 1 to 25 are needed skills to answer the research question on how cognitive and meta-cognitive skills affects lifelong learning with Blender software. The cluster value is above 3.00 bench mark and therefore shows that research question on how cognitive and meta-cognitive skills affects lifelong studying of the students in Blender software are to high extents. It was observed that the SD ranges from 1.43 to 2.32 which shows that the responses were close to the mean.

Discussion of the findings

The findings of the study were organized and discussed according to the research questions answered. The findings on the cognitive and meta-cognitive skills required for lifelong learning with Blender software showed that all the item statements listed are needed. This finding is in consonant with (CGSpectrum, 2023) caption 3d skills as needing ability to visualize abstract; experience with storyboarding which aligned with item 25; drawing ability and artistic mindset which agreed with item 14; visual storytelling and ability to draw in a variety of styles and genres. Indeed (2023) adduced that

visualization effect aligned with items 4, 5, 6 and 7 are needed by 3d designers for modification of an original image or video by adding additional creative elements to achieve the desired shot. Indeed, further adduced that character rigging which is the process of segregating a character into two parts, one being the surface representation of the skin and the other being the hierarchical collection of connected character parts is needed skill which the Animators require to identify how weight distribution, limb movements and skin types can influence the character's presentation. The author argued that mastering this technical skill can allow 3D animators to create characters that can express emotion through a series of images. Other skills according to Indeed are: colour theory which the animators generally use to give the scene a unique identity and design therefore, requires strong colour theory skills to help in mixing and matching colour combinations. This colour theory skill is consonant with item 2. The findings on how cognitive and meta-cognitive skills affect lifelong learning in Blender software reveled that all the Item statements are needed. Many of the item statements starting from item 2 to 17 were adapted from real life

skills to specific Blender skills. This is in agreement to the observations of Volodymyr, Nataliia, Serhii, Eduard and Svitlana, (2020) that experience gained in different areas of life can form positive and flexible (adaptive) educational prospects. Just as experiences formed from real life are applicable in 3d and animation design with Blender.

Conclusion

Based on the findings of the study, it is observed that natural skills which the respondents unanimously agreed that are needed in Blender Software 3D modeling are: ability to observe natural environment for new knowledge transferred into animation techniques, ability to identify: differences in natural environmental phenomenon, differences from natural situations. These skills are in accordance to what CG Spectrum (2023) called real-world understanding of proportional, depth, scale and physical space. Other skills needed are: ability to apply imaginative ideas into animation, ability to convert ideas into story, ability to transform ideas into characters, ability to identify beauty in nature, ability to recreate identified beauty in nature into graphics, ability to animate the recreated identified beauty in graphic, ability to modify characteristics of living thing into novel characters which (Lampel, 2023) attributed to be curiosity skill, ability to separate part from a whole, ability to isolate a whole from a part, ability to give suitable meaning to the isolated part from a whole, ability to accommodate different perspective to new ideas, ability to sketch or draw with: straight lines to form objects, curved lines to form objects and ability to interprets written stories with actions in the same vein. It was evident that the respondents are unanimous in agreeing that cognitive and meta-cognitive 3d digital skills are needed for

lifelong modeling techniques in Blender by undergraduates' students of computer science.

Recommendations

Based on the findings of the study, it is recommended that studies should be conducted:

1. on the needed lifelong skills for Blender software animation modeling techniques for job creation in the developing countries where unemployment is rife at 4.1% (NBS, 2023).
2. in another geographical area with different population and sample size.
3. with different animation modeling software like Maya or 3Dsmax to determine the skills needed by the respondents in that software for lifelong learning.
4. with different study design such as quasi-experimental in the same Universities or any other university with the same populations to determine the agreement or disagreement to the current study.

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