

ORGANIZATION OF INSTRUCTIONAL GRAPHICS IN PHYSICS LEARNING

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ABSTRACT

This study appraises the effects of multichannel presentation formats on learning important principle in classical mechanics (the principle of equivalence). The presentation formats were abstract icon, static leisure art, and the animated silhouette. The study was conducted (N=60) at the Remedial Science Department, University of Maiduguri. Results indicate that animated silhouette do not facilitate learning in this case. An interesting annotation is that the static leisure art and animat5ed icon groups pe3rformed better than the abstract icon on the abstract icon on the static leisure art problems. But the abstract icon group did not outperform the other groups on abstract icon problems. A tentative interpretation is that it is easier to move from static leisure art representation to an abstract than vice versa. Another interpretation is that it may be the case that the students in the tangible conditions expended more effort into applying abstract icon thinking on their tangible memory image.

Keywords: association, graphic instruction, Physics comprehension.

1 INTRODUCTION

Whilst at variance for the use of multichannel in didactic setting the common argumentation follows: “the eye is the gate way to the mind” [1, 2], that is, a picture is better than (a thousand words), an animatronics is better than a static graphics, sound is better than silence, doing is better than hearing, etc. on the other hand, there is not much pragmatically founded learning’s to sustain that line of arguing. In this learning attempt to address some questions vis-à-vis the efficiency, in regard to learning outcome of dissimilar multichannel presentational formats in the sphere of physics. The cognitive theories that are of interest in this learning are of two different categories: theories about learning in general and theories about the interaction of different presentational formats. There are erudite discuss within cognitive science between the proponents for the situated learning camp [3] and the orthodoxy’s camp [4]. The issues talk about are remarkable and have unswerving impact on the propose learning resource. However, imperative and motivating this discuss is, it is deem that the results of this learning could be appropriate in both camps. Making a distinction between skill acquisition and higher-order learning, in skill acquisition the outcome is competence. The outcome of higher-order learning on the other hand, is comprehensions [5, 6]. Skill acquisition has throughout the minute account of cognitive science been quite successful. Scholarship about higher-order learning, on the other hand, is still in its infancy [5]. At this premise, this learning aim at what [7] would call comprehension and what [5] might prefer to call higher-order learning. The theory put forth by [8] about the processing of information of the mind, “Dual-Coding theory”, in this theory he asserted that the human mind has two distinct (but interconnected) systems, one to process language and another for the rest of the information [8]. These theoretical arguments endorse the use of multi-channel presentational formats in instructional resources’. This assertion is also instituted on some empirical findings.[8, 9, 10] claim to have increased learning on procedural task by integrating aural and visual presentational approach.

2 PRESENTATION

Constructing instructional materials, whether it concerns textual, visuals or educational software, there are many different multichannel to present the learning material. The option of media puts different limitations on which presentational formats are promising. It is not feasible to use sound in an ordinary book, but there are still many options to be made: textual or pictures or images, etc.

2.1 Illustrations

Pictures has been methodically used in writing styles learning's by many erudite prospectus [11, 12, 13] and it relatively comprehensible that, used with some sagacity's pictures facilitate learning from text. Pictures in themselves can have different functions; [14] has classified pictures in writing styles (prose) learning according to five different functions: Organizational, Representational, Interpretational, Transformational and Decorational. There are no homogeneously design principles (theory) that state how to use pictures in all learning situations. The saying that "picture is worth more than a thousand words" is not always spot on [15].

2.2 Animatronics

Animatronics' have become trendy in computer graphics (computer-based) instructional products. Unfortunately, animatronics are often used to make an impact on rather than to teach [16]. There is a lack of theoretical source for the use of animatronics instruction. Animated graphics represent a compartment of instructional graphics but to which extent animatronics depart from and match with static graphic visuals is queried [16]. Relatively to static graphics, animated graphics can show information about three imperative visual characteristics: chronological, motion and trajectory. Animated graphics provide information about an object's in sequence (comical-strip). Animatronics provides information about an object's motion, if the motion is changing, and how it is moving (trail, patterns etc.) They can also show information about which way the object is moving. There has not been very much scholarship carried out on how, if at all, animatronics can facilitate learning. On the other hand some research's [17, 18, 19, 10, 20]. The challenge is that the outcome is mismatched. The use of animatronics instruction still shows to have significant prospective [9, 21, 22] found in a study that in a condition of text spent less time learning a different, but similar, task than did the users furnished with animatronics. Guidelines [21, 23], on how to design and use animatronics and animated graphics instructional materials some of these guidelines are:

Develop simpler animatronics rather than complicated ones. In general, the animatronics should be sufficiently complex to convey the important information within it, yet simple enough to be easily deciphered.

Animated graphic develop uncomplicated, motivating characteristics, sequenced with adjacent text to convey or capture imperative information within it.

Use animatronics when the instruction includes the use of motion or trajectory. In terms of motion animatronics can clearly show specific attribute of an object while it is moving, e.g. trajectory.

Avoid overused animation and distractive attributes.

The animation used in the instructional materials in this learning has been designed with these guidelines as a point of dissimilar modus operandi.

3 METHODS

Learning was conducted at Remedial Sciences Department University of Maiduguri. It tested if there were significant disparities in the learning outcome regarding the first Newtonian physics (principals of equivalence) when provided with multiple rendition of illustrations. This principal within Newtonian physics concerns acceleration and was well thought-out as apposite for animatronics and animation graphics according to [17, 18] perception of what information animatronics and animated graphics can provide more than static graphics and abstract. Sixty (60) first year remedial science students counted as subjects. The learning was conducted in three segments, with twenty (20) subjects taking part in the first segment; twenty (20) subjects took part in

second segment and the remaining twenty (20) subjects participating the next year (same course and same instruction). The principle of equivalence was part of the curriculum for the student's course of learning. The learning was conducted before treatment (the principle of equivalent) and after treatment in the course. All the subjects participated in the learning voluntarily. To ensure the face and construct validity of the instruments the five instruments were subjected to screening by experts in educational technology and in test and measurement; the final drafts were based on their comments and suggestions. The reliability of the instruments was established through test method. The instruments were administered twice in an interval of two weeks on twenty (20) students. The scores correlated yielded the reliability co-efficient index of 0.80, 0.65 respectively.

3.1 Design Procedure

To execute the learning a small computer graphics (CBI) instruction program was constructed. This instructional program attempt to instruct the student's one important principle in classical mechanics: the principle of equivalent. A test was also administered in the program in order to test if the subjects had previous comprehension of the instructional phase. The learning was conducted in groups 3 to 20 subjects at a time. On entering the ad hoc classrooms where the learning took place the subjects randomly were alienated in two classes. Those in experiment (1) randomly picked a computer with one version of the computer graphics (CBI) program. There were 20 computers (including personal laptops 'with the program fitted) in the classroom and each session therefore consisted of a maximum of twenty (20) participants. The experimental (2) were randomly placed in a different classroom and were open to the elements of the treatment using PowerPoint (CBI) instructions (sequential of the same program) and session consisted of twenty (20) subjects in the classroom. During the subjects maneuvers of the computer graphics (CBI) programs the research assistances were always at hand in the classrooms. The research assistance answered questions as regards the use of program, computers and other auxiliary operations of the program or other non physical science questions. When seated, the subjects followed the on screen or the PowerPoint projected instructions. After the stipulated time, subjects had finished they just left the classrooms and the researcher and his assistances collected the statistics that had been saved in the text files and the multiple choice answer sheets.

3.2 Resources' Graphic

The graphic icons were of three different kinds: Abstract, static, and animated. Abstract here means a classical icon with directional arrows representing vectors which represent forces (gravitation and immobility) (Figure 1.). This illustration was rendered for this learning linking to the same area in physic learning.

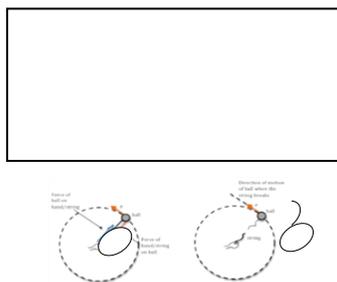


Figure 1. The abstract icon

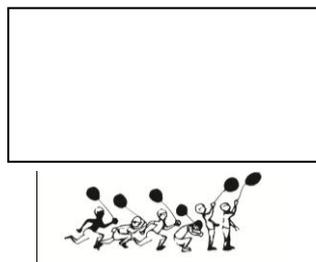


Figure 2. The static leisure art

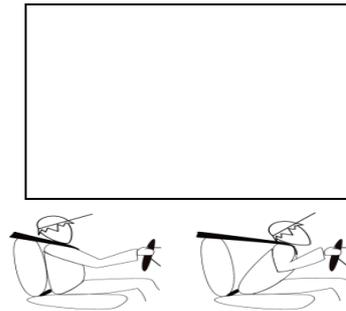


Figure 3. The animated silhouette

The static leisure art is a more every day experience sign-types of illustration which the student can recount to; in this case “running human figures” seen from the side (visual perspectives), with a balloon pendulum tiered around on their heads (Figure 2). The animated silhouette illustration consists of the same setting as the static with the exception that ‘maniplo-spatial’ sequences added. In the animation, the sequence proceeds from the car standing still, accelerating, travelling at consistent speed, applying its breaks until it comes to a halt (Figure 3). The sequence is repeated.

3.3 The computer graphics (CBI) program

The computer graphics program consisted of four segments: an introduction, a learning segment, an experiment segment, and plodding segment. The introduction consisted of a text narration which explains some practical details about the program. The introduction also contained three backdrop queries regarding the subject’s age, gender, and previous knowledge of Newton’s laws (principles of equivalence). The learning segment consisted of a text narration and the illustration described above. The text narration was divided in four parts containing increasing more detailed explanations of the principles of equivalence. When the subjects were ended (with the learning segment, before the experiment segment) they were asked to guesstimate (on level ranging from 1-10) how much they felt they learned. The experiment segment consisted of four different types of test: The first challenging task of the subjects was to envisage what would happen to flexible flags fasten to standing pendulums on a circle top of a kick wheel (a potter’s manual wheel). This test was varied so that in one test the situation consisted in a rotating circling top where in another, the circling top is not rotating. Henceforth referred to as query number 1 and 2 or the flags (animatronics’) query. The second challenge consisted in the subjects filling the missing gap in one abstract type visual given that a particle is accelerating to the left or the right. Hereafter referred to as query number 3 and 4 or the abstract icon queries. The third challenge the subjects were to predict what would happen to the balloon pendulum on the heads of the “running human figures” given that they were accelerating. Keeping an even pace or suddenly stopped for a crossing car. Henceforth referred to as query number 5, 6 and 7 or static leisure art queries. The fourth challenge the subjects were to predict what would happen to the teddy-bear hugged on the ceiling of a car and the seat-belt around the driver. Given that the car is accelerating keeping an even pace or abruptly applying its breaks. Hereafter referred to as query number 8, 9 and 10. Or the animation silhouette queries.

Multiple choice queries were used all through. After having answered the query the subjects were asked to motivate their choice, I. e. by simply explanation. Subsequent to each query the subjects were asked to guesstimate (on level ranging from 1-10) on how difficult they knowledgeable the challenge to be, and also, how positive they were that they had answered it correctly. In the plodding segment the subjects were asked how much they felt they had visually captured, deciphered and learned. There was also some query vis-à-vis the use of the program itself. There were four different versions of the program interconnected to the four different types of graphics rendition. Within the four different versions there were two orderings of the test query’s 1 and 2, totting up to six different versions. The variation in presentation order was performed to eliminate any effects of presentation order. In both versions the two queries about the flexible flags on a kick wheel (porter’s wheel) came first. In the version 1 and 2 queries about the missing gap (parameters) followed, and

after that the three queries about the teddy bear hanged in the car. In version 2 it was the other way around.

4. RESULTS AND DISCUSSION

The participant's answers were grouped according to which kind of graphics they accredited during the learning segment. These groups hereafter called abstract icon, static leisure art, animated silhouette and animatronics. In all there were 60 participants resulting in 15 in abstract, 15 static, animated 15 and 15 animatronics group.

4.1 Quantitative results

The responses counted were as correct when absolutely correct. In queries 3 and 4 there had to be four correct reports to count as a correct act in response (the correct picture and three strictures). On query 1 and 2 there were approximately identical results in all the groups. There was almost the same number of corrected answers. (Table 1) and the mean values of the guesstimate, on how certain they were of the answer and how hard the queries was experienced to be, were very close to each other.

Table 1. The number of right answers on the flag queries (1&2) (The total number of subjects in each group within parenthesis).

Group/Questions	Number	Rotating Turntable	Not Rotating Turntable
Abstract icon	20	16	16
Static leisure art	20	8	17
Animated silhouette	20	6	17
Total	60	30	50

With reference to the abstract iconic queries (3 and 4) there was a drop in performance in the animated silhouette group compared to other groups (Table 2). On the other hand the abstract icon group were significantly ($p < 0.05$) more certain about their answers being correct compared to other two groups.

Table 2. The number of precise answers for the abstract iconic queries (3&4) (The total number of subjects in each group within parenthesis.)

Group/Question	Number	Accelerating	Accelerating	Accelerating
Abstraction	20	4	7	4
Static leisure art	20	7	13	3
Animated Silhouette	20	1	14	1
Total	60	12	34	8

On the queries 5&6, the static leisure art and animated silhouette groups were better than the abstract iconic group. The teddy bear effect query 7 is obvious (Table 3).

Table 3. The number of precise answers for the balloon queries (5, 6 & 7).

Group/Question	Acceleration	Breaking	Construct Speed
Abstraction	7	7	7
Static leisure art	14	13	18
Animated silhouette	15	14	18
Total	36	34	43

4.2 Qualitative Results

When comparing the answers and the explanations, it seems that most of the learners (subjects) that answered correctly also understood the principles well. There were a few obvious guesses but they often made a wrong guess. Beside the multiple choice answers, the subjects were asked to give an explanation in the language of their choice or English. After each question, the subjects were asked to estimate preferentially at a degree of tendencies on a 1-10 scale how difficult they experienced the challenge to be, and also how confident they had answered them correctly. Whilst judging against the answers and the motivations it seems that most of the subjects that answered correctly also could identify with the principle well. There were a few noticeable “guessers” but they often made a wrong guess. Beside the multiple-choice answers, the subjects were asked to motivate each answer in a “vernacular” These motivations show some very interesting preferences. There seems to be a connection between the sort of language used and the illustration provided.

5. CONCLUSIONS

The justification to have the flag queries (1 and 2) was that it would be an unknown presentation format for all the groups. If one of the groups would have a better score on the first query this could be taken as an indication that the presentation format of this group made for a better and yawning understanding of the principle of equivalence. This did not turn out, but this does not say that there are no divergences between the presentation formats. More erudition is needed to sort these queries out. It is logical to guess that the static leisure art and the animated silhouette groups should outperform the abstract icon group on the balloon queries. Moreover, this is because they are more familiar with the presentation of the challenge. Successively this line of reckoning the abstract icon should outperform the static leisure art and animated silhouette groups on the abstract queries. This did not occur. This could be for the reason that the abstract icon query was too intricate. A tentative interpretation is that it is easier to move from a static leisure art representation to an abstract than vice versa. It can be surmised that physics students are more used to abstract representations and descriptions and this in turn made it for the static leisure art and animated silhouette groups to perform well on abstract challenges. Another interpretation is that it may be the case that the students in static leisure art and animated silhouette conditions expended more effort into applying an intangible thinking on their concrete reminiscence image, whereas the students in the abstract condition had difficulties in seeing the concrete ‘applicability task’ of the principle. Subjects were asked to rate the intricacies of the challenges and how convinced they were in their answers being correct. The static leisure art and animated silhouette groups rated their confidence significantly lower on the abstract icon’s challenges and slightly lower on the other challenges. One proposal is that the static leisure group has deeper understanding of the principle but when presented with a presentation of the challenge they had never seen before they felt uncertain. This however does not account for the fact that the abstract icon group did have about the same confidence level on the static leisure art queries (5, 6 and 7). A doable reason for the learning involvement in the abstract icon group lies in the fact that the behavior of the balloon is counterintuitive. In the accounts to their answers, many students sustained their reasoning on preceding practice.

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