Learning the Solar System

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Abstract

This purpose of this paper is to examine lesson plans introducing the solar system to 3rd grade learners using computer technology. Introducing the solar system through technology will have several advantages. This will give the learner the opportunity to learn basic information about the solar system in which we live and introduce them to search methods using the internet. This paper covers 7 different modules or lesson plans for each teaching sessions. As a result of this lesson, the learner will know basic information about the planets of the solar system and will have developed a simple presentation covering information found through research. Visual contexts and research principles that were used to develop each of the lessons are also discussed. Links are also provided to each of the lessons and corresponding visuals.

Module 7, Visualizing Processes was a step out from learning about the solar system. This particular module involved the process of changing a tire and was designed for the driver education course attended by a beginner driver.
Learning the Solar System

This paper covers the research, implementation and results of 7 separate lesson plans covering the learning of the solar system by third grade learners. Module seven will cover a different subject but will be similar in approach to learning to use technology in learning.

Program Standards

The lesson plans in this program meet several of the program standards covered in the syllabus. Module 3, Advanced Organizing and Module 5, Memory Load, meet several criteria including 2.3 Computer-Based Technologies and 2.4 Integrated Technologies. Module 6, program standard 2.4 Integrated Technologies was used.

In module 3 Advanced Organizing and Module 5 Memory Load, the visuals were designed to draw upon and build on the prior knowledge of the learner. Considerations were made for future lesson plans when the names of each of the planets, the orbital lines and position of planets were all designed. The use of the numbers in Module 5 was to reflect directly upon the learner’s prior knowledge. The majority of the follow-on lessons used a similar format in order to reduce cognitive loads and to generate familiarity with the learner. The interactivity within the visuals was designed to give the learner a start in finding information about each of the planets. As a result of pretest results, prior knowledge of internet search techniques were lacking therefore websites containing information were provided for the learners through interactive visuals in the lesson plans.

In Module 6, Mental Models visual, program standards 2.4 was utilized by the interactivity of the visual and the links to the corresponding links. The leaner is able to scroll and click on each of the planets and visit a website for that planet. At the website, there is much more supporting information for the learner to access and use for the final presentation.
AECT Standards

The lesson plans for the separate modules follow several AECT Standards. In Module 8 Mental Models, the learner explores each of the items on the webpage by clicking and seeing the pop-up window appear explaining what planet they have clicked on. The visual also gives them a choice on selecting a planet or a non-planet item. Regardless of the selection, the learner has the ability to develop a mental model by seeing the actual planet and recognizing it by its size, color and shape. This would be included in Standard 1: Design.

The lesson plans generated for each module would fall under AECT Standards 1.3 Instructional Strategies. The lesson plans work in sequence (except for module 7) and follow a gradual progression of learning information and using technology to achieve the objectives. Each lesson plan follows a similar format where the first 30 minutes of the lesson is dedicated to lecture, discussion and answering any questions. The following hour is dedicated to astronaut teams (pairs of two learners) visiting the lesson visual on the computer and conducting web searches for information.

Module 3 Advanced Organizer

There were several considerations made when developing this lesson plan and visual. First and foremost was the goal of this module and how to accomplish this established goal. This module is going to be the first in the series of sequential lesson plans therefore such concerns as information, format, overall goals and learning objectives for subsequent modules had to be considered at the beginning of this module. The goal of this lesson visual was to design a simple format that could carry through to all of the subsequent lesson plans but with a little variety to keep learner motivation high. Another consideration was the learning environment, such as how the astronaut teams would be decided and how would they be responsible for the end of lesson presentation as a team and as individuals.
This first lesson will consist of a pretest and then a 30 minute lecture introducing the Learning the Solar System lesson plan. There would be only 30 minutes allotted for this first day for teams to see the lesson visual and become familiar use of the computers. After taking the pretest, it was decided the prior knowledge of the 3rd grade learners was limited only very basic knowledge of the solar system. Such information as the location of the sun, what were moons, being ability to differentiate between stars and planets, were such examples of prior knowledge. This was considered relevant prior knowledge therefore Comparative Advance Organizers were used (Clark & Lyons, 2004).

Comparative Advance Organizers were used in this lesson to associate prior knowledge with new information through the chosen visuals (Clark & Lyons, 2004). After the format was decided upon, graphic elements of the planets were chosen due to their simplicity as well as their familiarity. The images of the planets that were chosen were very common when researching and gathering data. Using common graphic elements to illustrate the planets was important to reduce future cognitive loads and to begin organizing the information to be retained in long term memory. Colors were chosen for their visual interest as well as simplicity. The color and the images were used to reduce the chance of seductive visuals which in this case would be such things as stars, meteors, moons, etc. (Clark & Lyons, 2004).

Link: [http://edtech2.boisestate.edu./rileyp/module3.advance.organizer.html](http://edtech2.boisestate.edu./rileyp/module3.advance.organizer.html)

Module 4 Attention Graphics

The goal of this lesson is focusing the attention of the learner. Using a common format adopted by the first module, bright contrast colors were introduced to help the learner to further focus on the learning objective: learning the planets names by size and color. Implementing guideline 2 in Clark and Lyons Graphics for Learning (2004), text color was also used exclusively to motivate the learner and maintain their attention. According to Clark and Lyons, “applying colors in order to cue learning can be very effective if high contrast colors are used” (Clark & Lyons, 2004).
In creating this visual, the first consideration was accomplishing the learning objective. Consideration of the cognitive loads placed on the learner due to the limited experience in using computers and learning the new information was also a dominant factor in designing this visual. The design also had to be fun and colorful to keep the learner attention focused on achieving the learning objective. Using basic spheres, but in proportional in relation to each other kept with the simplistic intent of this visual. Typography elements were used to convey motion and excitement about discovering the solar system. The interactive component was added as a final measure to engage the learner’s short term memory in recognizing the planets. It was also the intent of this visual to be used repeatedly and as a future reference for learners having difficulties in transferring this data from short term working memory to long term memory.

This visual would be used by the astronaut teams as they began their data collection on the classroom computers. Using the Guided Discovery Instructional Strategy covered in our text, the astronaut teams would be assisted in logging into the computers and onto the visual webpage for this lesson. Interaction between team members as they used this visual to access the information would help in transferring the data into long term memory with each astronaut. Reinforcement of data transfer/memorization would also be a product of this visual as the interactivity is used.

Link: http://edtech2.boisestate.edu./rileyp/module4.attention.graphics.html

Module 5 Memory Load

In this visual, the first and foremost consideration was in reducing cognitive loads of the learner. In order to do this, considerations on layout, graphic elements and content complexity was made. The objective of this lesson is to reinforce what has been learned up to this point and to form associations with prior learner knowledge with learning new information.

Experience level of the learner and prior knowledge determined the graphic elements of this visual. Using numbers instead of accurate representations was done in order to develop the
relationship between the numbers familiar to the learner, and the order of the planets from the
sun. The format of the order of planets starting left and finishing left is consistent with previous
lessons to reinforce short term memory and promote memory transfer. The rings were placed
in such to convey movement of the planets on their orbits which is also consistent with
previous lessons.

The interactivity was placed within the numbers for several reasons. One reason the links
were provided was to help the astronaut teams that were lacking in web search experience to
find sources for their presentation. The choice for the links, Enchanted Learning, has been
widely used for learner resources in this particular age group. Another reason the links were
added was to generate interest and motivation for learners to search further for data and not
just the one link that was provided.

As explained in Clark & Lyons Graphics for Learning (2004), the Instructional Strategy
followed in this course would be a Guided Discovery. The learner would be guided through their
web searches but would be able to work at their own pace when working on their
presentations. This lesson will begin with a thirty-minute discussion on what has been learned
up to this point, any questions that the learner may have and to introduce this lesson. Upon
conclusion of the discussion/lecture, astronaut teams would be formed (that were decided in
previous lessons) and allowed to explore on the computers after viewing the lesson visual
(Clark & Lyons, 2004).

Link: http://edtech2.boisestate.edu/rileyp/module5.memory.load.html

Module 6: Building Mental Models

The purpose of this lesson is to help learners build mental models while supporting near
transfer. Up to this point, the sequence of lessons has introduced the learner to accurate
representations of the planets and their orbits as well as representations which is supported by
their prior knowledge. This lesson seeks to combine all the information covered up to this point
and begin forming mental models in the learner.
Based on one of the theories discussed in Clark & Lyons’ Graphics for Learning (2004), An Organizational type of Explanatory Graphics were used to build and organize mental models in this lesson (Clark & Lyons, 2004). Using a familiar format developed in previous lesson, the learner begins using short term, working memory in recognition of the order of the planets from the sun and their names when viewing this visual. The black background has now been introduced in this lesson depicting space offering a gradually more accurate depiction of space. The accurate representations of the planets were also used in order for the learner to begin the transfer of this information from working memory knowledge into long-term memory.

The interactivity was developed after the webpage had been completed. In the initial design pop-up windows would appear as the learner clicked on each individual planet. Through revisions and discussions, it was determined that these windows would be limited in information due to size constraints. It was then decided to delete the windows and place links within the visual. These links would then guide the learner to a webpage developed by Kids Astronomy. This website was chosen due to the learner-friendly formatting and ease in which the learner can find information. The rollover interactivity was adopted from Module 4 Attention Graphics to help support the learned information from working memory to long term memory.

This lesson will consist of a 30 minute lecture/discussion on information that has been covered so far in previous lessons. As in previous lessons, this would be a Guided Discovery lesson described in Clark and Lyons’ Graphics for Learning (2004). Immediately following the lecture/discussion, learners would be allowed to access the lesson visual and begin discovering information as astronaut teams. The instructor will provide assistance to the teams as needed but will allow discovery of information at their own pace with little guidance. This computer research by the teams will last approximately one hour.

Link: http://edtech2.boisestate.edu/rileyp/module6.mental.model.html
This particular lesson was a departure from the previous lesson plans, Learning the Solar System. This lesson plan was developed for the 11th grade learner or the beginner driver. The objective of this lesson is to use familiar visual cues to help learners build near-transfer skills, specifically, changing a tire.

The yellow background color of the Procedure Visual was chosen to convey caution. This color is common throughout the driving experience and should unconsciously register in the learner’s mind that caution should be used when changing a tire. The familiar graphic image of the road sign was used to support prior knowledge and recognition from the learner. Each of the pop-up images were also designed in the same road sign format to further support learner prior knowledge and recognition. The images within the pop up windows were used to add a little humor to the otherwise dull procedure of changing a tire. This was done in keeping with the target learner of this lesson.

The interactivity was generated in order to show each step of the procedure. As the learner clicks on each step, a pop up window appears clearly showing the appropriate procedure for the step. As discussed in Graphics for Learning on page 228, warnings and cautions are included in the procedures in order for the visual to stand on its own (Clark and Lyons, 2004).

The lesson follows a receptive instructional strategy discussed in Clark and Lyon’s Graphics for Learning (2004) where there is a 30 minute lecture with this visual used as a reference by the instructor. This visual will be used during the lecture and could be downloaded by the learner and used for later reference. A demonstration of changing a tire will follow the lecture.

Link: [http://edtech2.boisestate.edu/rileyp/module7.visualizing.html](http://edtech2.boisestate.edu/rileyp/module7.visualizing.html)

Module 8: Visualizing Concepts

This lesson plan continues with the Learning the Solar System group of lesson plans. In developing this lesson plan, more information regarding the planets is introduced while building on the short term memory information learned in prior lessons. The visual constructed
for this lesson plan uses familiar graphic images as well as counterexamples to allow the learner to gain more understanding of the solar system (Clark and Lyon, 2004).

In this visual, the black background that was used in Module 6 Mental Models is used to further support through consistency, the prior knowledge of the learner. The images of the planets used in prior lessons were also used to support the short term memory of the learner and to also introduce new information. The format of the visual changed slightly in order to keep the learner from possibly transferring incorrect information into long term memory. If this visual kept with the standard format of previous lesson plans, the risk is that the learner will begin learning incorrectly that planets are always aligned on the right side of the sun. By changing the perspective of the learner as the solar system is viewed, it will reinforce the idea that the planets are continuously rotating around the sun. New graphic elements such as stars and comets are introduced as counterexamples in order to reinforce what are planets and what are not. (Clark and Lyon, 2004). According to Clark and Lyon’s Graphics for Learning, (2004) Counterexamples are useful to avoid confusion that occurs when new concepts are introduced and could be confused with existing learned concepts. (Clark and Lyon, 2004)

The interactivity was generated after all visuals were placed and were designed to engage the learner and for information transfer. Images and typography in the pop up windows were used in order to make the subject matter fun and interesting to the target learner. This was done while introducing more information. It was discussed that the windows should pop up beside each of the planets as they are clicked on by the learner, but was decided against in order to reduce the cognitive loads that such positioning may cause. If the pop up informational window is in the same place each time an image is clicked on, then the learner knows exactly where to look each time for the information.

As with prior lessons, this lesson will begin with a thirty minute lecture/discussion on information covered and new information that will be introduced. This time will also be used for any assistance with presentations that may be needed. This will be a Guided Discovery Strategy formatted lesson plan which the learner will be teamed with one other learner and be known as astronaut teams. These teams will be consistent with the teams chosen at the
beginning of the modules. As with prior lessons, these astronaut teams will be using classroom computers after the lecture/discussion to use this visual as well as accessing other websites to gain information for their presentations.

Link: http://edtech2.boisestate.edu/rileyp/module8.concepts.html

Module 9: Visualizing Facts

In this final lesson plan for the Learning the Solar System modules, the previously established format was not used. Consideration that the learner should know the names and order of the planets was given thus the cognitive loads would be at a minimum by changing the format. Focus was placed more on the learner’s limited working memory capacity when subjected to new information rather than the long term memory capabilities of the learner. The objective of this lesson plan is to provide factual information by engaging the learner in the visuals’ interactivity and graphic images.

There were several formats considered when developing this visual for this lesson. Graphic elements similar to the ones used in Module 8’s pop up windows were used to promote short term transfer of the new information. After considering several options, the format of the current visual was decided upon. The format of this visual was selected for several reasons. The first reason for its selection was to minimize the confusion between the order of the planets in regards to the sun and the order of the planets in regards to their size. If prior lesson visual formats were used, this could have confused the learner. The second reason this format was decided upon was due to the simplicity and ease of the interactivity compared to other options. After the format was established, similar graphic visuals were chosen in order to create interest and engage the learner. The information covered in the lesson was considered complex for the target learner therefore recognizable, age-compatible images were selected thus reducing the cognitive loads of the learner.

The interactivity was considered a key part of this visual in providing information to the learner. Size and shape of the pop up windows were made compatible with the graphic images
in order to keep the learner engaged. For example, Saturn was named after the Roman god of agriculture, therefore a graphic image representing a farmer was used because of the learner recognizing the image of the farmer. Using prior knowledge of the learner was very important as the graphic images were selected.

In this lesson plan, astronaut teams would visit the lesson visual and finalize any information collected up to this point when the lesson began. Using the Guided Discovery Instructional Strategy, the astronaut teams would be gathered and a discussion and review will be conducted by the instructor. Any assistance needed by the teams would be administered by the instructor.

Link: [http://edtech2.boisestate.edu/rileyp/module9.visual.facts.htm](http://edtech2.boisestate.edu/rileyp/module9.visual.facts.htm)

Conclusion

Lesson plans contained in this paper have one objective. The objective is to use technology in helping the learner comprehend and retain information regarding our solar system. Using various techniques and strategies, these lesson plans enable the learner to obtain more information more efficiently and retain it in long term memory. Generating interest and making learning about our solar system fun were hopeful by-products of these lesson plans.
References

Professional Biography

I have 14 years of sales and marketing experience in the marketing services industry. I am currently on active duty with the Air National Guard and have approximately 23 years of service of flying on C-130s. My military service has given me the opportunity to instruct many of our newer recruits and is why I’m getting my M.ET. at Boise State. My ambitions are to work for a military contractor in the simulation and training field.