
Name: **Chris Blundell**

Subject: **7072CTL - Communication Technology in Education**

Course: **Master of Education**

Assignment: **1b - Academic Journal Article**

“Using Macromedia Flash® to Assist Conceptualisation of the Seasons”

Table of Contents

Title	3
Abstract	3
Introduction	3
Stage 1 - Research and Analysis.....	4
Analysing Common Instructional Methods	4
Understanding the Primary Target Audience	5
Stage 2 - Design.....	7
Pedagogical Context	8
Instructional Design	9
Media Design.....	10
Stage 3 - Development	14
Developing Critical Elements	14
Testing Critical Elements.....	16
Polish	16
Stage 4 - Implementation and Evaluation.....	16
Conclusion	16
References.....	18
Appendix A - Research and Analysis Questionnaire	20
Appendix B - Conceptual Schema / Flowchart	22
Appendix C - Testing Questionnaire.....	23
Appendix D - Publishing Criteria	24

Please note: Appendix D includes the publishing guidelines for Australian Educational Computing, which is the intended publisher for this article. For the purposes of clarity, however, the images included are in colour, rather than grayscale as required by publisher.

Title

Using Macromedia Flash® to Assist Conceptualisation of the Seasons

Abstract

The seasons concept is poorly understood by students and is commonly the subject of misconceptions. Macromedia Flash® has been increasingly used to develop learning objects that have successfully promoted engagement and learning. This paper articulates the processes of researching, designing, developing and reviewing a learning object to support the conceptualisation of the seasons. The importance of efficient and in-depth research and analysis of the concept and the target audience, and the subsequent identification of appropriate pedagogical contexts and instructional design is emphasised.

Introduction

The processes that contribute to the seasons are commonly misunderstood by students, adults and even elementary (primary) education students (Adams & Slater, 2000). Anecdotal evidence of poor student comprehension of factors that contribute to the seasons, prompted the development of an interactive, animated multimedia curriculum resource.

Macromedia Flash® is increasingly used as the development platform for computer-delivered curriculum resources or, as they are more commonly known, learning objects. A pilot review of the effectiveness of The Learning Federation's learning objects suggested that students were more engaged in learning and interest levels increased by interactive multimedia content delivered by online tools (Freebody, 2005).

This article is an expression of the research, design, development and review of a learning object - 'The Reasons for the Seasons' - created using Macromedia Flash® to support students to conceptualise the factors that contribute to seasons. It is expressed in stages that are informed by Instructional System Design processes (Abbey, 2000 and Jonassen, et al, 1999).

Stage 1 – Research and Analysis

Prior to designing and developing the learning object, it is crucial to research and analyse the relevant concepts and instructional methods, and where possible, identify common misconceptions. It is also important to gauge the level of prior knowledge and conceptualisation capacity of the target audience. Design decisions are more effectively made in the light of this information.

For the purposes of clarity, and to provide an exemplar of the process, the specifics of research and analysis stage for this project have been elaborated.

Analysing Common Instructional Methods

A review of a range of commonly available references - text-based and online - (Tarbuck & Lutgens, 1994, 1998; Crowder, 1995; National Museums Liverpool, 2003; Wikipedia, 2006; HowStuffWorks, 2006) suggested that teaching and learning of the seasons concept is commonly supported by diagrams and illustrations. Typically these are simplified and not drawn to scale; rarely did they include an indication of scale. Woolf (2004) argues that common misconceptions about the seasons are the result of misleading terminology, over-simplified and inappropriately scaled illustrations, or inappropriate emphasis of the relative importance of contributing factors. It was concluded that illustrations and animations should be used to assist conceptualisation and these should be developed carefully.

Misconceptions about the seasons are common, according to Adams and Slater (2000). The most frequently identified misconception is that Earth's proximity to Sun at certain points on its orbit causes the seasons (Adams & Slater, 2000; Bailey & Slatter, 2004; Henriques, 2000; Science Netlinks, 2002). Another misconception is that the seasons are caused by the Earth's axial tilt bringing one hemisphere closer to the Sun than the other (Adams & Slater, 2000). Both these misconceptions would seem to be, as Woolf (2004) suggests, the result of poor comprehension of scale. Addressing misconceptions was considered to be an important function of the learning object. Given that misleading use of scale may contribute to the

generation of misconceptions, clear statements about accuracy of scale were included in the design.

Understanding the Primary Target Audience

A questionnaire was specifically designed and utilised for the purpose of more fully understanding the primary target audience (refer to Appendix A for a copy of the questionnaire). Students in the senior phase of learning (Years 10-12) at [REDACTED] were the primary target audience for the initial implementation. Three-quarters of the Year 10 cohort and all of Year 11 and 12 Earth Science students, responded to the questionnaire; a total of 106 students.

The results indicated that 63% of the sample had been taught about the seasons, though the greater majority identified Years 5 to 7 as when they learnt about seasons. It is worth noting that the seasons concept is not formally taught as part of the Years 8-10 Science curriculum at [REDACTED]. Just over 99% of the respondents were able to name the four seasons.

The students were asked to write a clear description of the cause(s) of the seasons; diagrams were permitted. 82% of the sample responded; refer to table 1. 26.4% of the respondents provided a clear and correct description of one of the causes for the seasons. An additional 16% were able to provide simple descriptions that, though correct, lacked significant detail and took the form of simple statements of facts. It is worth noting that 57.4% of the responses were incorrect, inconclusive or unclear. The two common misconceptions about the causes of the seasons, as identified in the literature, were evident in the students' responses: the proximity to the sun (24.1%), and one hemisphere being closer to the sun (11.5%).

Table 1: Responses to request to describe the cause(s) of the seasons

<i>Analysis of response</i>	<i>Percentage of responses to this item</i>
Correct description of a cause of the seasons	42.5%
Incorrect description of a cause of the seasons	44.8%
Inconclusive or unclear or wrong description of a cause of the seasons	12.6%

The fourth item on the questionnaire was designed to determine if, when given a direct statement, students would be able to correctly determine the accuracy of that statement (refer to table 2).

Table 2: Classification of accuracy of statements about seasons

Statement		Correct	Student responses			
			True	False	Uncertain	No Response
1 (4.1)	When the northern hemisphere experiences summer, the southern hemisphere experiences winter.	TRUE	89.6%	3.8%	4.7%	1.9%
2 (4.2)	The days in summer are longer than in winter.	TRUE	90.6%	4.7%	3.8%	0.9%
3 (4.6)	In winter the sun is higher in the sky than in summer.	FALSE	21.7%	40.6%	31.1%	6.6%
4 (4.3)	We experience summer when Earth is closer to the sun.	FALSE	45.3%	33.0%	19.8%	1.9%
5 (4.4)	The tilt of the Earth on its axis controls the seasons.	TRUE	58.5%	10.4%	31.1%	0.0%
6 (4.5)	During summer the southern hemisphere receives more direct sunlight than in winter.	TRUE	63.2%	8.5%	26.4%	1.9%
7 (4.7)	When the ground is heated by sunlight, it releases that energy as infra-red radiation.	TRUE	31.1%	16.0%	50.0%	2.8%

Notes:

1. The statements from the questionnaire have been reordered for the purposes of analysis.
2. *Blue* shaded cells indicate where the majority of the students *correctly* classified the statement. *Yellow* shaded cells indicate where the majority of the students *incorrectly* classified the statement or were uncertain.

The data suggests that a large majority of respondents were able to correctly classify the generalised statements about the seasons: alternation of seasons between hemispheres, and changes in length of day (statements one and two). While 40.6% of the respondents correctly classified statement three, the remaining data is spread across the other categories. These data suggest that while students are aware of generally observable evidence for the seasons, they are not necessarily aware of more specific evidence, such as the changes in the angular height of the sun. The data for statement four is consistent with the data from item three and that of Adams and Slater (2000), indicating that proximity to the sun is a commonly held misconception. Responses to statements five to seven suggest that while a significant

percentage of students were able to correctly validate statements about specific factors, many were uncertain.

Question five was included to determine the percentage of students who were aware that air is mostly heated by infra-red radiation from the ground. The response rate suggests that the majority of students were not aware of this factor. Understanding this factor is crucial to appreciating seasonal variation and the data demonstrates the importance of ensuring this factor is clearly expressed in the learning object.

The last question was designed to assess the students' ability to comprehend a conceptual model for explaining how the angle of incidence of sunlight controls the level of solar heating of the ground. 68.9% of the students were able to answer the question correctly. The remaining responses were relatively evenly spread (6.6% to 11.3%) across the remaining options. This suggested that the conceptual model would be useful, though it would need to be carefully constructed.

Analysis of the data suggests that most members of the target audience have a superficial appreciation of the factors that contribute to the seasons. Misconceptions are relatively common. It does seem, however, that they are capable of processing the relevant concepts and drawing conclusions based on presented information and illustrations. Hence, it was determined that the learning object would need to address all relevant concepts and dispel the two common misconceptions.

Stage 2 – Design

Given the results of the research and analysis stage, the design stage initially addressed the pedagogical context and then instructional design. Both elements, in combination with the issues identified in stage 1, controlled the design decisions for the visual and interactive elements.

Pedagogical Context

Once the learning outcomes/objectives were identified, a pedagogical context that was consistent with computer-based curriculum resources was sought. Constructivist learning theory (Bruner, 1966; also see Huitt 2003, Fraser & Tobin, 1998 and Marsh, nd) was determined to be most appropriate for two reasons: the interconnected and developmental nature of the season concept lends itself to constructivist pedagogy; and secondly, the questionnaire data combined with anecdotal evidence indicated the students had a personal appreciation of seasons. This personal appreciation should provide an experiential foundation for learning the relevant concepts.

Understanding the various factors that cause the seasons would seem to require the conceptualisation of more complex and less immediately tangible processes. Flash animations allow for the creation and utilisation of dynamic, engaging content that, in combination with interactive elements, should more effectively scaffold the constructivist conceptualisation process (Richards, 2003). Animated illustrations or virtualisation (such as, MaterialWorlds, 2002) seem to promote more effectively conceptualisation of complex concepts (Yair, 2001).

Edelson et al's (2002) articulation of constructivist theory, the "Learning-For-Use design framework" is the specific pedagogical context (refer to table 3). While it would seem that a Flash animation could successfully support the three steps of Learning-For-Use, Gance (2002) argues that computer-based learning environments can not effectively facilitate all elements of constructivist learning. In particular, it would seem that while computer-based learning effectively facilitates engagement, it does not as effectively support authentic problem-solving and human interaction (Gance, 2002). 'The Reasons for the Seasons' was designed to facilitate the 'construct' phase of Learning-For-Use. It is intended that the 'motivate' and 'refine' phases will be supported by teacher-led activities - discussions, group question and answer sessions, and challenge activities to test and apply learnt concepts.

Table 3: Overview of the Learning-for-Use Design Framework.

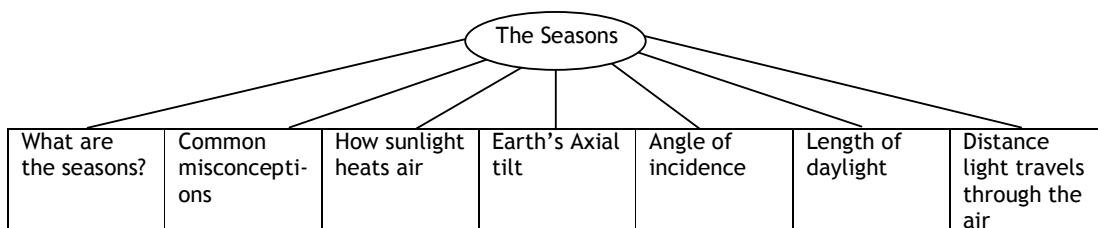
Step	Design Strategy	Student Experience
Motivate	Activities <i>create a demand</i> for knowledge when they require that learners apply that knowledge to complete them successfully.	Perceive need for understanding
	Activities can <i>elicit curiosity</i> by revealing a problematic gap or limitation in a learner's understanding.	Experience curiosity
Construct	Activities that provide learners with <i>direct experience</i> of novel phenomena can enable them to <i>observe</i> relationships that they encode in new knowledge structures.	Experience or observe phenomena
	Activities in which learners receive direct or indirect <i>communication</i> from others allow them to build new knowledge structures based on that communication.	Hear, view, or read about phenomena
Refine	Activities that enable learners to <i>apply</i> their knowledge in meaningful ways help to reinforce and reorganize understanding so that it is useful.	Apply understanding
	Activities that provide opportunities for learners to retrospectively <i>reflect</i> upon their knowledge and experiences retrospectively, provide the opportunity to reorganize and reindex their knowledge.	Reflect upon experiences or understanding

(Edelson, et al, 2002 pp 4)

Instructional Design

Given the relatively complex nature of the seasons and that they are caused by a range of factors, the instructional design was developed according to a content-driven model (Dornan, 2004). The relevant pre-requisite knowledge, causal factors and the previously identified misconceptions were organised in the form of a conceptual schema; as depicted in figure 1.

Figure 1: First tier of the conceptual schema



The first tier of the conceptual schema was then expanded to include the relevant concepts or processes. For example, the 'how sunlight heats air' section was expanded to include the following concepts: air is a good transmitter of sunlight, clouds and atmospheric dust contribute to heating of air, and air is predominantly heated by infra-red radiation from the ground. Interconnections between all elements were then identified. Once complete, the conceptual schema formed the basis for a flow chart; refer to Appendix B.

In order to facilitate engagement and to promote a sense of conversational interaction, a question and answer mode of presentation was incorporated in the design (refer to Figure 2a). The questions are posed by a simply animated character, called 'Herschel' (after William Herschel who discovered infrared radiation). Herschel was included to down play the perception of the learning object being a textbook replacement, by making the interaction seem less formal than a textbook and more concerned with supporting understanding than communicating information. The design called for Herschel's expression to change from a look of uncertainty to one of comprehension over the duration of the instructional phase of each section. The character's eyes move to 'look at' each element as it appears. Both mechanisms, while not directly adding to the instructional intent, provide non-verbal cues.

Media Design

Successful instructional media is dependent on the engagement of the user (Dornan, 2004) which, in turn, is dependent on the ease-of-use of the learning object. The following design decisions were made to facilitate ease-of-use.

To maximise the available screen space, the dimensions of the Flash® project were set to 750 pixels wide by 525 pixels high, thereby providing to the largest possible space for animations, while still allowing the resource to be used on monitors running at 800 by 600 pixels. All fonts were sans serif typefaces implemented to promote on-screen readability and to remain consistent with standardised sans serif font paradigms common to Microsoft and Apple operating systems.

A high contrast, predominately blue and orange complementary colour scheme was used to promote readability. The dark blue background colours recedes in comparison to the brighter yellow-orange text and interface elements, thereby separating the background from the foreground. Text colours were designed to contrast tonally with its immediate background. Subtle versions of the images used on the title screen of each section were incorporated as

blue tinted images in the background, providing a reminder of which section the user is accessing.

To support a consistent the user experience and promote readability, the ‘content’ sections of the learning object were designed to conform to a common layout template. All elements appear in the same place on screen for all sections; refer to figures 2a and 2b.

Figure 2a: Design of graphical user interface and navigation - ‘The Reasons for the Seasons’

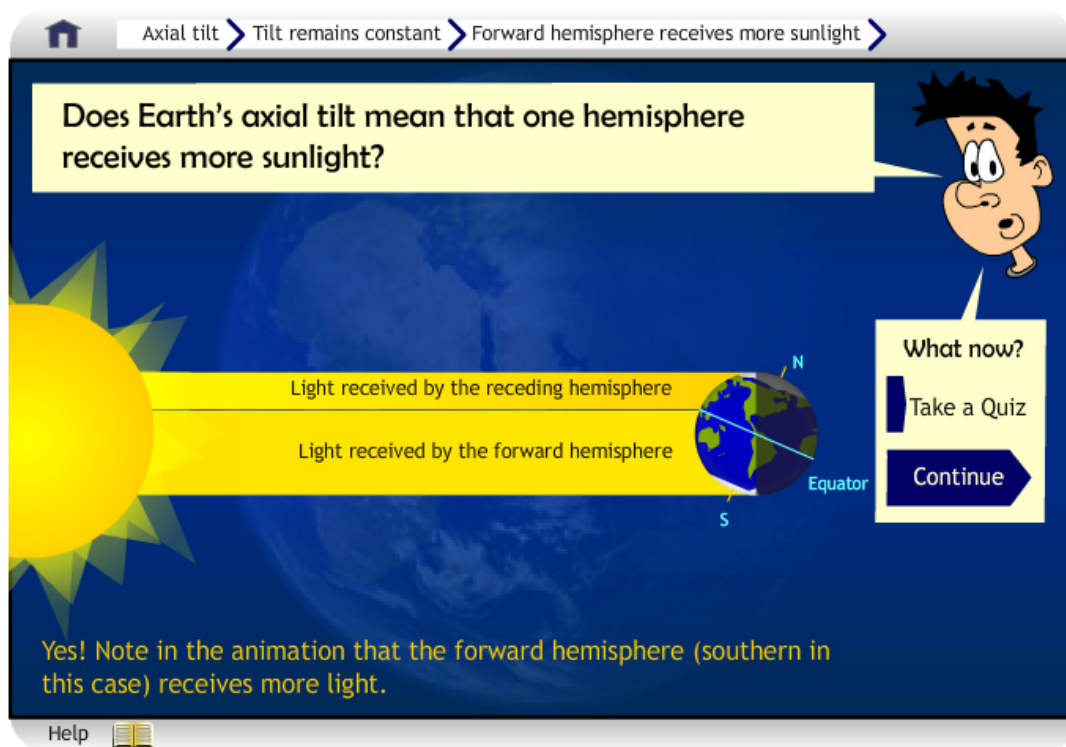
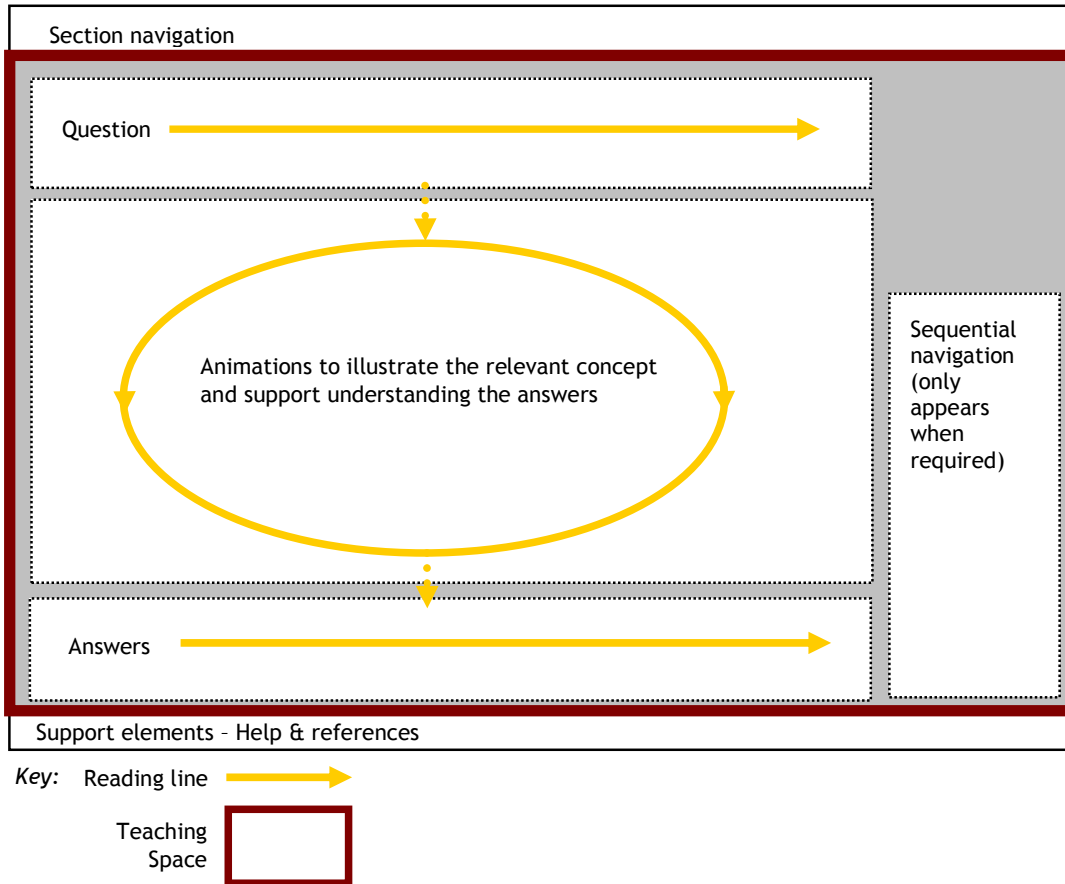


Figure 2b: Layout template - 'The Reasons for the Seasons'



Navigation is achieved via two independent mechanisms - section navigation, which is always available at the top of the screen, and sequential navigation, which appears as required in the bottom right-hand side of the teaching space (refer to figures 2a and 2b). Two mechanisms have been provided to give the user freedom to decide how they will navigate the learning object. A conscious decision was made not include a pull down menu system with access to all sections and sub-sections. The developmental nature of the concepts in the sub-sections is significant and comprehension would be negatively impacted by the act of indiscriminately selecting topics. The site map, as a supplement to navigation, does allow for the user to move to specific sections of the learning object, if required.

The section navigation paradigm was designed to be reminiscent of Apple's iTunes® and provide a degree of familiarity thereby assisting ease-of-use. It should also reinforce the

sequential nature of concepts within section. The user can select previous concepts without going back through each 'screen', as is common in World-Wide Web browsers.

Sequential navigation allows the user to progress through the topics from first to last. The user is not required to return to the main menu, though the option is available. Links to other topics that directly relate to the on-screen concept are provided at several points in the learning object.

The section navigation and support elements - help, site map and reference links - were designed to sit outside and remain visually separate from the 'teaching space' (refer to figure 2b). The light grey gradient background to these elements was designed to promote readability of text but not compete with the blue and orange colour scheme in the teaching space.

It is worth noting that the text-based information has been designed to be presented in smaller 'chunks'. The intention was, firstly, to restrict the amount of on-screen text to a maximum of four lines, commonly less to promote readability; and secondly, give the user time to understand the conceptual interaction between the animated illustrations and the explanatory text. The stacked arrangement of the 'Question', 'Animation' and 'Answer' sections was designed to reinforce the relationship between these elements, and to promote, without mandating, a reading order (depicted in figure 2b). The section and sequential navigation elements are isolated by distance and placement on screen to avoid confusion.

Design responses to the outcomes of the research and analysis stage were largely concerned with ensuring clarity of illustrations and animations, plus minimising of the potential for misconception. The earth-sun scale is difficult to accurately depict in illustrations - the sizes of the earth and sun are very small in comparison to the distance between them. This makes the simultaneous depiction of earth and sun, and the distance between them, impossible. To ensure that the user has a sense of the scale, an animation was included in the 'one hemisphere is closer to the sun segment' of the 'common misconceptions' section (refer to

Appendix B, 3.3 in the flowchart) that depicts the magnitude of the earth-sun distance. The design stipulated that illustrations not drawn to scale would include a label to that effect.

Stage 3 – Development

Developing Critical Elements

The development of a complex learning object, such as ‘The Reasons for the Seasons’, can be quite involved. Initially the focus of development was on the elements critical to successful completion: the creation and implementation of the content, and functioning interactive navigation. Elements such as the introductory scene, the help pages, and even much of decorative features, were scheduled for development only after the critical elements were complete and tested.

Several Flash®-specific development strategies were implemented to provide an efficient build process. To minimise overall file size, most assets were incorporated in the library, and used as instanced objects in various scenes. This also made on-going refinement and artistic polish of assets an efficient process. Elements on the timeline were separated into folders - background elements, GUI, text, references, ActionScripts and scene specific layers. Layer labels were used to ensure quick interpretation of the content/purpose of a layer. Refer to figure 3.

Figure 3: Screenshot of the layer organisation on the timeline



To ensure that the layout and presentation remained consistent across all sections of the project, the first 'content' scene was developed in its entirety, including navigation and functionality. This scene was then duplicated and renamed. The scene-specific content and keyframes in the duplicated scene were removed and replaced with new elements. This procedure increased efficiency of development.

Frame labels were used for navigation purposes. 'GoTo' and 'Play' ActionScripts were set to refer to frame labels rather than frame numbers. This allowed for the movement of keyframes on the timeline without disrupting functionality.

Testing Critical Elements

Once the critical elements were created and functional, small-scale testing and evaluation was undertaken. Present and past Earth Science students as well as one teaching colleague were asked to use the learning object and then respond to a questionnaire (refer to Appendix C). Data gathered suggested the test group found the learning object easy and fun to use, the illustrations clear and easy to comprehend, and the navigation functional. Most respondents indicated that the learning object improved their understanding of the seasons and would prefer to use it over a textbook.

It is worth noting that a majority of the respondents indicated they would still prefer a teacher explanation over using the learning object. This reinforces the importance of implementing this learning object as component of a “learning-for-use design” framework. This might also suggest the value of including a voice-over option to support the learning styles of people predisposed to auditory processing.

Polish

Issues identified during the previous testing phase were corrected. Following this, the non-critical and decorative elements, as well as artistic polish were finalised.

Stage 4 – Implementation and Evaluation

The final stage of development, which will occur after the due date for this assignment, will be to implement “The Reasons for the Seasons”. As stated previously, this interactive learning object is designed to be used as part of a larger constructivist teaching/learning strategy. As part of this strategy, it is the author’s intention to ask students after the first full implementation for feedback this will be used, in combination with teacher observation of student use and outcomes, to identify further refinements.

Conclusion

Flash® allows for the development of highly interactive and engaging instructional media which makes it an effective tool for supporting the conceptualisation of more involved and less immediately tangible concepts/processes. It is a beneficial tool for teachers to create

animated illustrations that would seem to be more effective than static textbook illustrations. It is important, however, that the design, development, implementation and review of learning objects are considered and planned processes based on detailed research and analysis.

References

- Abbey, B (2000). Instructional and Cognitive Impacts of Web-Based Education. Idea Group Publishing: London.
- Adams, J.P. & Slater, T.F. (2000). Astronomy in the National Science Education Standards. Journal of Geoscience Education, 48(1), 39-45.
- Bailey, J.M. & Slatter, T.F. (2004) A Review of Astronomy Education Research. The Astronomy Education Review, 2 (2), 20-45.
- Bruner, J. (1966). Toward a Theory of Instruction. Cambridge, MA: Harvard University Press.
- Crowder, B. (1995) The Wonders of the Weather. Australian Government Publishing Service: Canberra.
- Dornan, E. (2004) Road Map for Educational Multimedia Design: A Content Developer's Approach. Retrieved March 12, 2006: <http://it.coe.uga.edu/itforum/paper80/paper80.htm>.
- Edelson, D.C., Salierno, C., Matese, G., Pitts, V., & Sherin, B. (2002). Learning-for-Use in Earth science: Kids as climate modelers. Paper presented at the Annual Meeting of the National Association for Research in Science Teaching, New Orleans, LA. Retrieved March 19, 2006: <http://myworldgis.org/userdownloads/pdf/LFU_PF_NARST02.v3.doc>
- Freebody, P. (2005). Learning objects are tracking well. EQ Australia, 3 (3), 7-9.
- Fraser, B.J. and Tobin K.G. (ed) (1998). International Handbook of Science Education. Dordrecht: Kulwer Academic Publishers.
- Gance, S. (2002). Are constructivism and computer-based learning environments incompatible? Journal of the Association of History and Computing, 5(1). Retrieved March 19, 2006: <<http://mcel.pacificu.edu/JAHC/JAHCV1/K-12/gance.html>>
- Henriques, L (2000) *Children's misconceptions about weather: A review of the literature*. Paper presented at the annual meeting of the National Association of Research in Science Teaching, New Orleans, LA, April 29, 2000. Retrieved May 1, 2006, from: <<http://www.csulb.edu/%7Elhenriqu/NARST2000.htm>>
- HowStuffWorks (2006). What causes the seasons? Retrieved March 13, 2006, from: <<http://science.howstuffworks.com/question165.htm>>
- Huitt, W. (2003). Constructivism. Retrieved March 19, 2006 from Valdosta State University Web Site Educational Psychology Interactive: <<http://chiron.valdosta.edu/whuitt/col/cogsys/construct.html>>
- Jonassen, W.H., Tessmer, M and Hannum, W.H. (1999) Task Analysis Methods for Instructional Design. Lawrence Erlbaum Associates: New Jersey.

- Marsh, G.E (nd). AIL 601: Constructivism. Retrieved March 19, 2006:
<<http://www.healthnet.org.np/training/msoffice/access/WW189.htm>>
- MaterialWorlds (2002). Earth's Tilt and the Seasons Worksheet. Retrieved February 27, 2006, from:
<http://www.materialworlds.com/sims/SolarSystem/worksheetSolsticeEquinox.html>>
- MSNBC (n.d.) Why do we have seasons? Retrieved February 4, 2006, from: <
<http://www.msnbc.com/news/251727.asp>>
- National Museums Liverpool (2003). What Causes the Seasons? Retrieved March 15, 2006, from:
<http://www.liverpoolmuseums.org.uk/nof/sun/access/san2_3b.html>
- Richards, S.L.F (2003). The Interactive Syllabus: A Resource-based, Constructivist Approach to Learning. The Technology Source Archives. Retrieved March 19, 2006, from: <http://technologysource.org/article/interactive_syllabus/>
- Science Netlinks (2002) The Four Seasons. Retrieved May 1, 2006, from:
<http://www.sciencenetlinks.com/pdfs/seasons_teachsheet.pdf>
- Tarbuck, E.J. & Lutgens, F.K. (1994). Earth Science (7th ed.). New York: Macmillan College Publishing Company.
- Tarbuck, E.J. & Lutgens, F.K. (1998). The Atmosphere: An Introduction to Meteorology (7th ed.). New Jersey: Prentice Hall.
- Wikipedia (2006). Seasons. Retrieved March 19, 2006, from:
<<http://en.wikipedia.org/wiki/Seasons>>
- Woolf (2004) The Good, the Bad and the Ugly: Instructional Materials for the Seasons and Color. (WWW site). Retrieved March 19, 2006, from: <<http://www.sci-ed-ga.org/pdfs/sdinservice.pdf>>
- Yair, Y (2001). 3D-Virtual Reality in Science Education: An Implication for Astronomy Teaching. Journal of Computers in Mathematics and Science Teaching, 20 (3), 293-305.

Appendix A – Research and Analysis Questionnaire

Year Level:

1. Have you been taught (at school) what causes the seasons?

- Yes No

If so, when did you learn about seasons? Tick all appropriate boxes.

- Year 5 Year 6 Year 7 Year 8 Year 9 Year 10 Year 11/12

2. Name the seasons.

.....

3. As clearly as you can, describe the cause(s) of seasons. You are welcome to use diagrams.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

4. Read each of the following statements about seasons. Decide whether each statement is true or false. Circle the appropriate response.

Statement	Circle your response		
i) When the northern hemisphere experiences summer, the southern hemisphere experiences winter.	True	False	Uncertain
ii) The days in summer are longer than in winter.	True	False	Uncertain
iii) We experience summer when Earth is closer to the sun.	True	False	Uncertain
iv) The tilt of the Earth on its axis controls the seasons.	True	False	Uncertain
v) During summer the southern hemisphere receives more direct sunlight than in winter.	True	False	Uncertain

Statement	Circle your response		
vi) In winter the sun is higher in the sky than in summer.	True	False	Uncertain
vii) When the ground is heated by sunlight, it releases that energy as infra-red radiation.	True	False	Uncertain

5. Read the following statement:

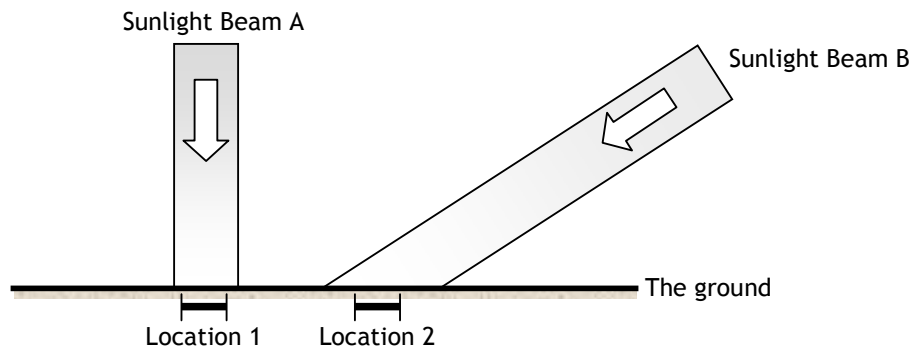
Air near the surface of the Earth is heated when sunlight passes through it.


How accurate is this statement?

- It is completely accurate; surface air is only heated by sunlight.
- It is mostly accurate; surface air is also sometimes heated by the ground.
- It is mostly inaccurate; surface air is mostly heated by the ground.
- It is completely inaccurate; surface air is only heated by the ground.

Ans:

6. Study the following diagram. It shows two beams of sunlight (A and B) striking the ground. The beams have the same strength.

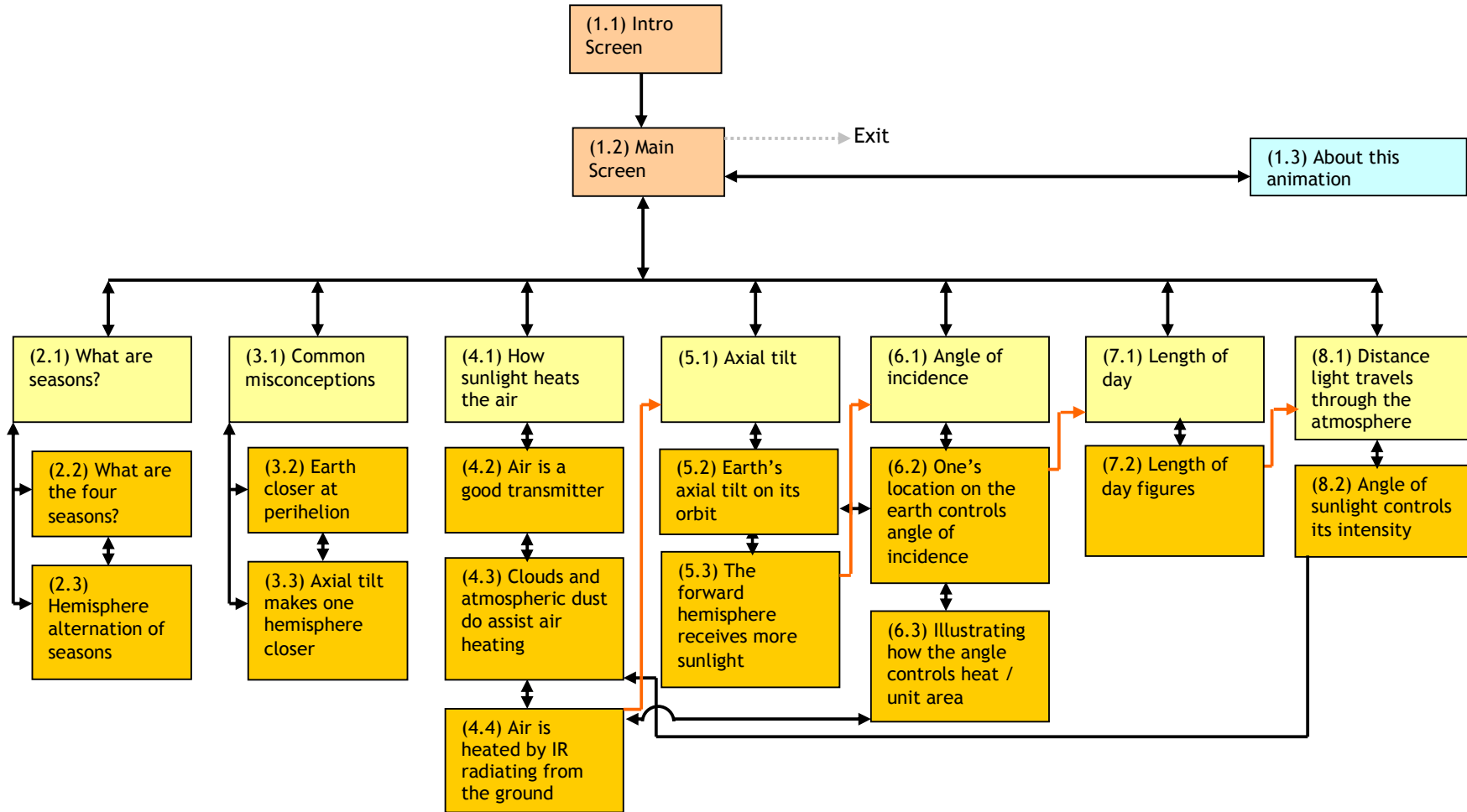


At which location will the ground be heated more? Note both locations are the same size, and both are smaller than the width of the beam. Consider only the space indicated by the marker ().

- Location 1
- Location 2
- Both locations will be heated to the same extent.
- I do not know.

Ans:

Appendix B – Conceptual Schema / Flowchart



Appendix C – Testing Questionnaire

1. What did you *like* about the learning object?

2. What did you *dislike* about the learning object?

3. Rate the following statements on the scale of 1 (strongly disagree) to 5 (strongly agree). Indicate your response by *changing the text colour one number to maroon*.

	Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
3.1	The learning object was easy to use.	1	2	3	4	5
3.2	The learning object did not improve my understanding of the seasons.	1	2	3	4	5
3.3	The illustrations were clear and easy to understand.	1	2	3	4	5
3.4	I got 'lost' while trying to navigate through the learning object.	1	2	3	4	5
3.5	If this learning object was used in class, I would have better understood the seasons.	1	2	3	4	5
3.6	I would prefer to read a textbook than use this learning object.	1	2	3	4	5
3.7	I would prefer a teacher explanation than use this learning object.	1	2	3	4	5
3.8	I now understand more about the causes of the seasons.	1	2	3	4	5
3.9	The learning object was fun to use.	1	2	3	4	5

4. List/describe any sections of the animation that did not function as you expected.

5. Were any of the illustrations unclear or confusing? If so, please indicate which and why?

6. Would this learning object be better if the information was included as audio?

7. Do you have any suggestions for improvements?

8. Do you have any other comments to share?

Appendix D – Publishing Criteria

Journal: Australian Educational Computing
Source: http://www.acce.edu.au/policy_pubs.asp

The editorial panel welcomes contributions in the form of original articles, letters, reports and reviews. Authors should ensure that their manuscript conforms to the American Psychological Association (APA) bibliographic convention.

All manuscripts should be clearly printed on one side in a publishable style (eg diagrams placed appropriately). Apart from the title page no author identification should appear on the manuscript. Figures, tables and graphics should be provided in camera-ready form. Photographs should be black and white rather than coloured. Authors should limit articles to a maximum of 4000 words and include an abstract of 100-150 words. Electronic copy in the form of plain (unformatted) text files (9cm MS-DOS or Macintosh format, or via email to the editor), should be submitted with the paper copy. Authors should include a brief biographical statement.

Papers contributed for the Theme Papers or Contributed Papers sections will be anonymously refereed by at least two members of the Editorial Board. All submitted material will pass through an editorial phase to maintain journal standards and balanced coverage.

All articles accepted may be published in both print and electronic forms.

All material is copyright unless otherwise stated in writing and may not be reproduced in any form without the permission of the authors.

Opinions expressed by contributors do not necessarily represent the views of the editorial panel or the Australian Council for Computers in Education. The ACCE does not endorse the products or services advertised in this journal.

Deadlines for the next two journals are advertised in the current journal.