A wide variety of multimedia learning objects exist today that cover various topics for different audiences. Affordable computer hardware and user-friendly software allow many learning objects to exist. However, pedagogic and usability qualities of these products vary. To evaluate these products for learning effectiveness, the literature was reviewed to understand factors and criteria that must be considered (Reeves & Harmon, 1994). Usability factors include navigation (Oppermann, 2002), ease of use, aesthetics, media integration, structure (Heller, Martin, Haneef, & Gievska-Krliu, 2001), compliance, adaptability, documentation and help, and user satisfaction (Lee, 1999). Pedagogical factors for each learning object include communication with other users, timeliness of feedback from teacher, motivation, content quality, learner-content interactivity (Kennedy, Petrovic, & Keppell, 1998), assessment and testing, goals and objectives, sequencing of content (Kennedy at al., 1998), and learning afforded (Reeves & Harmon 1994).

The rubric represents and includes standards, whose detailed meanings were used to evaluate two learning objects. Standards were weighted, after agreement during rubric design, and ratings were assigned (Baumgartner & Payr, 1997) based on how well standards were met by the learning objects assessed. Two learning objects were chosen for independent assessment, and the subsequent selection of a winner. The first selection is Healthy Sleep (2008), which presents a comprehensive review of sleep, effects of disrupted sleep, overview of sleep disorders, history of sleep research, etc. The second selection is Sleep Disorders (2012) which overviews several sleep disorders, sleep deficiency, and their individual and societal tolls.

Healthy Sleep (2008) learning object is a sophisticated resource constructed with input from researchers and clinicians from Division of Sleep Medicine at Harvard University. Text, video, interactive graphics, and audio are integrated flawlessly to effectively present a rich array

of knowledge to the public, physicians, students, and researchers. Navigation is intuitive even with the large amount of information that is presented. The learning object can be accessed with all major browsers on most computers, increasing value to the public. Overall, the site is inviting and aesthetically pleasing with elegant colors, icons, fonts, and other screen elements that draw in the user. Content is free from errors. Media are integrated very well with text, video, and interactive graphics that are presented synergistically.

Healthy Sleep (2008) has a tiered structure so that users with less time or interest can look at one-page frames showing summaries that are integrated with informative videos that are a good length for communicating substantial knowledge without being overbearing. Videos include interviews with members of the public in addition to academic experts, giving the site a very human and communal feel. Those with more time or interest are able to read extended texts that are reinforced with strategic use of interactive graphic modules, videos, and well-placed graphics. Users may use interactive graphics to learn about history of sleep research; sleep cycles; sleep patterns of normal patients versus those that have sleep disorders; and sleep patterns of children, the elderly, shift workers, and other populations. These elements also include quizzes that reinforce knowledge for learners.

Healthy Sleep (2008) uses tabbed menus on top of each page frame, in addition to an ever-present menu system on the left side for quick navigation and to reduce chances of a user being lost. Site map, glossary, video index, technical help, overview of the site, and list of contact information for subject matter experts and designers are available in the footer of each page. Contact information for academics is particularly useful as they allow users to interact with those persons if desired. There are a few issues needing correction however they appear easy to update due to the site’s modular and standardized design. Links for help and video index that

exist at the top of each video are broken, while links to the same content on the bottom of each page function well. The broken links may surprise and distract the learner and may tarnish an otherwise excellent multimedia learning object. Additionally, videos and interactive content are incompatible with iPhone and some mobile devices. Small screens may not be suitable for the expansive content, but iPad or other tablets may be appropriate platforms for using this resource. Correcting the broken links as well as upgrades and testing to allow for flawless usability on tablet devices are advisable.

Healthy Sleep (2008) excels pedagogically, due to excellent content and high capacity for user-content interaction. The site is intrinsically motivating to use for learning, and content is not only accurate but is prepared by top experts in the field. Content is flexibly designed to provide options for lower cognitive load (Heller et al., 2001) via summary text and videos, and higher cognitive load via extended text, and interactive graphic elements and quizzes. All content, including assessments, are presented in a relatable, informative manner covering a variety of sleep disorders, importance of sleep, human results of bad sleep habits, and sleep across different populations in society. This learning resource is therefore comfortably and effectively applicable to the real world. Although contact information for academics and clinicians are listed, it would be advisable to include more prominent access for users who wish to contact a central advisor. Additionally, social web 2.0 dimensions would allow users to interact with each other, which would enhance the utility of this learning object. However, these criticisms are small, as there is such high capacity for learner-content interaction with content that is so well made that need for a coach or for learner-learner interaction is minimal.

Sleep Disorders (2012) health tutorial by National Library of Medicine meets many usability criteria in an objective sense, but overall is not designed well. Colors are sterile and un-

inviting. The narration is at times alarming and uninviting, with on-screen text dictated verbatim and accompanied by basic and sometimes repetitive cartoons. Video with real-life persons would have personalized this resource, however the content is overall un-engaging with unsophisticated graphics and voiceover anyway. The site presents three options for users: an interactive version, self-playing tutorial, and text summary. Unfortunately, the interactive version is not at all interactive and is identical to the self-running version, except the user mouse-clicks to advance the program along. If user does not click quickly enough, a distracting voice comamnds the user to do so.

Learner-content interaction is minimal, and learner-learner and learner-teacher interaction are non-existent which make the learner experience a lonely one and contribute to low real-world applicability. Intrinsic motivation and user engagement are also low. While the content is accurate, user satisfaction is not very high because content is presented in a dry, distant, and overly rigid manner without ability for much exploration. There are no learner assessment opportunities in any form, and goals and objectives do not exist. Content is disjointed as smaller modules covering each sleep disorder are presented separately, without building upon or integrating earlier content or knowledge; this limits integrated understanding. The content could conceivably be used in real-world situations by some however this utility is not particularly intuitive and greatly diminished due to the impersonal, disconnected, and non-interactive nature of content. This may not allow for substantial internalization or breed much thought for application to real settings by the user.

The Harvard Healthy Sleep (2008) learning object is the selected winner. This is due to its inviting, well-designed interface and excellent pedagogical design that immerse the user into an interactive, enriched, well-integrated, and personalized multimedia environment that

encourages learning in pleasurable manner and not a chore. It is a good example of multimedia elearning.

[Peyvand Ghofrani] [DETC620] [Section 9040] [3/18/2012]
[Evaluation of Two Multimedia Learning Objects for Learning Effectiveness]

Weighting of evaluation criteria
E = essential
* = very important
# = important
+ = less important

Rating of Evaluands
* = meets standards
# = partially meets standards
+ = marginally meets standards
0 = does not meet standards
Essential criteria are Pass/Fail

USABILITY CRITERIA

Criteria	Standards	Weight of Criteria	Evaluand 1 (Harvard)	Evaluand 2 (NLM)
Navigation	Students are able to navigate the site – exit, forward, back, main menu, help, glossary, etc.	E	**P**	**P**
	Links and hyperlinks are current and functional	E	**P**	**P**
Ease of Use	Program can be run on multiple platforms	E	**P**	**P**
	Program and related functions are easy to maneuver	*	*****	*****
Aesthetics	Content is free of spelling and grammar errors	E	**P**	**P**
	Fonts, graphics, and icons are appropriately sized and legible	E	**P**	**P**
Media Integration	Appropriate use of media – print, audio, video, etc.	*	*****	#
	Audio and video were operational and efficient	E	**P**	**P**
Structure	Users are able to track their progress through the program	*	*****	*****
	Contents are well organized – site map, headings, etc.	E	**P**	**P**
Compliance	Contents are free of bias, adhere to technical standards and specifications, and accessible to users of various disabilities	E	**P**	**P**
Adaptability	Program can be easily updated and changed to reflect current information	*	*****	#
Documentation /Legibility	Manuals, tutorials, and help guide are available and easy to read	*	*****	**+**

[Peyvand Ghofrani] [DETC620] [Section 9040] [3/18/2012]
[Evaluation of Two Multimedia Learning Objects for Learning Effectiveness]

Criteria	Standards	Weight of Criteria	Evaluand 1 (Harvard)	Evaluand 2 (NLM)
User Satisfaction	Program provided a positive learning experience for the user	*	*****	**+**

PEDAGOGICAL CRITERIA

Criteria	Standards	Weight of Criteria	Evaluand 1	Evaluand 2
Communication	Learners are provided opportunities to communicate with each other and instructors	*	**#**	**0**
Timeliness	Instructor provides timely feedback to student (regarding questions, assignments or other matters)	*	**#**	**0**
Motivation	Program enables intrinsic motivation for learning	E	**P**	**F**
	Program uses media to engage users and enhance learning	E	**P**	**F**
Content	Content is accurate, current, and appropriate to the intended audience	E	**P**	**P**
	Content aligns with learning goals and objectives	*	*****	**#**
Interaction	Program offers opportunities for interaction with content for key learning objectives	*	*****	**0**
Assessment	Program offers opportunities for self-check, formative, and summative evaluations throughout the program	*	*****	**0**
Goals and Objectives	Provides clear goals and learning objectives for the module/program	E	**P**	**F**
	Goals and learning objectives are appropriate for the intended audience	*	*****	**+**
Learning	Program provides opportunities for real world problem solving	*	*****	**+**
	Program provides opportunities for reflective learning	E	**P**	**P**
Sequencing	Program has a logical, orderly and sequential flow, building on prior content and knowledge	E	**P**	**F**

Evaluand 1 (Harvard) **E:14P,0F *:11 #:2 +:0 0:0**
Evaluand 2 (NLM) **E:10P,4F *:2 #:3 +:4 0:4**

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