IETMs in Academia:

The Efficacy of Using IETMs for Learning to Program in Alice

Master's Thesis

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Abstract

The Interactive Electronic Technical Manual (IETM) is a tool that presents middle to highly technical information to users with a varying range of experience in an understandable and hands-on manner. IETM technology has been used for large military and industrial maintenance and training systems. The IETM's ability to provide on-demand content for audiences with a wide range of expertise makes it a great candidate for other learning environments. The University of Wisconsin – Platteville's student taking the Introduction to Engineering (GE 1030) Software Engineering Module has been learning to program in Alice, an introductory programming environment, for the past two years using PowerPoint® slides, websites, and a large amount of hands-on help from course instructors. In this thesis, the Alice IETM was developed, which facilitates GE 1030 students' learning of Alice. An evaluation of the IETM's effectiveness compared to traditional PowerPoint® slides was performed. It was found that the results provide no significantly measurable difference between the effectiveness of PowerPoint® slides and IETMs as reference materials for teaching college students to program in Alice.

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1 Introduction

Teaching students technical material is difficult. Often a student needs instruction from someone with specific experience to effectively learn new technical material. This is especially true with learning programming languages [JLM06]. Traditional documentation and tutorials utilize PowerPoint® slides and Web pages to augment traditional lectures. In many cases this means that the instruction is linear, and targeted to a hypothetical average student. When a question cannot be answered with the documentation, pupils must find a different source for the answer; often an instructor or classmate.

The Interactive Electronic Technical Manual (IETM) is designed to eliminate the need for separate documents for different levels of experience. They have been tested and produced for military and large-company technical documentation for more than 25 years [FUL85]. However, IETMs have not been studied in the classroom setting.

This thesis supports the claim that IETMs can be effectively used as classroom instructional tools for learning to program in Alice, thereby increasing the effectiveness of instruction and increasing the number of students per class. This claim was tested by examining the impact of an IETM on the performance of UW-Platteville introductory engineering students. A prototype of an IETM framework was created and a small control study was performed to measure the successes and failures of the IETM in comparison with the traditional reference and lecture materials. The experimental group used the Alice IETM for their reference materials. The control group used PowerPoint slides for their reference materials. It was expected that:

- The experimental group would spend significantly less time finishing the assignment than the control group.
- The experimental group would rate the understandability of the reference materials significantly higher than the control group.
- The experimental group would rate the usefulness of the reference materials significantly higher than the control group.
- The experimental group will spend significantly less time on individual Alice topics than the control group.

The results indicated that the experimental group, students who used the IETM, rated the reference materials no differently than the students who used the traditional reference materials. It was concluded that more research and larger sample sizes are needed to support the claim that IETMs can be effectively used as classroom instructional tools for learning to program in Alice.

1.1 Background on IETMs

IETM stands for “Interactive Electronic Technical Manual”. IETMs are used for presenting users with technical material on an as-needed basis in a structured and easy-to-use format. The term IETM was first used by Joseph Fuller of the United States Navy as early as 1970 [FUL85]. Adapting on the existing microform technology in place, a uniform specification was proposed in order to create technical documentation for ships and ship parts to replace the bulky mass of paper documents and provide a quick and efficient way for technicians to access information. In the late 1980's, Fuller and a team of engineers worked at building a series of pilot systems for the Navy and Air Force respectively named the Navy Technical Information Presentation System (NTIPS) and the Computer-based Maintenance Aid System (CMAS). The systems used documentation stored according to a Standard Generalized Markup Language (SGML) that could be later presented via computer as an electronic document. The NTIPS was evaluated for its ability to serve as the maintenance system for the flight control system of the F-14A aircraft. Similar evaluations were also performed for the Technical Information system of the AN/SPA-25D radar repeater. Both tests showed remarkable success rates in technicians' ability to find and isolate faults – 100% fault isolation for IETM users, compared to 58% fault isolation of paper manual users [JF92]. The research on IETMs, as they were called, clearly showed that technicians and engineers preferred using the electronic documentation over the preexisting paper manuals. Throughout the 1980's and into the 1990's these IETM systems were expanded and tested for efficiency with remarkably consistent results. It was reported that the use of IETMs reduced corrective maintenance time, reduced the number of false removal of good components, improved the accuracy of maintenance reports, reduced training requirements for new technicians, and reduced system down-time due to maintenance [FUL85][DTR91].

Since the inception of the IETM, its popularity had grown immensely within a few years. In 1987, due to the rapidly diverging usage by military and weapons manufacturers, the Joint Industry/Government Pageless TM Committee was formed to standardize the use of the IETM. In 1989, The Tri-Service IETM Working Group was commissioned to develop the military standards to support the Navy ATA, Air Force ATF, and Army LHX. The three standards created were the MIL-M-87268, the MIL-D-87269, and the MIL-Q-87270 [FUL85]. These three documents referenced each other to specify a standard for all IETM producers to follow. However, during the 1990's it was found that many IETM systems were not interoperable for viewing – IETMs developed with one system were not viewable on another system [JOR99]. The rapidly changing internet technology and the diverging development IETM systems introduced dramatic changes to IETMs that the MIL specifications could not support. By the end of the 1990s, the MIL specifications were not being widely accepted and were being replaced with S1000D IETMs [LFJ03].

During the formation of the Tri-Service IETM Working Group a new standard was being produced by The Aircraft European Contractors Manufactures Association (AECMA) and the British Ministry of Defense (MoD). The European standard for production of technical documentation using XML, S1000D, was started in 1984 and was first released in 1989 [WIL07][SKU11]. Since its release and subsequent releases, it has become the most popular solution for specifying the XML content of an IETM [LFJ03]. The S100D standard can be complicated for inexperienced users, and often a professional consultant is needed to guide IETM producers through large amount of documentation rules [SKU11].

IETMs today are used as interactive maintenance and operational manuals for very large and complex machinery, vehicles, ships, and aircraft. They have been used for presenting many types of technical and non-technical information in situations where the users of the tool have varying degrees of experience, and the concept being discussed is complex enough to constitute different ways of completing the task or understanding the concept [LB10]. Essentially, "The IETM viewer presents only the data actually required for a particular application and only that data needed at a particular point in time." [LFJ03]

For large systems, the production of an IETM can take years to complete. Because the S1000D specification is complicated by itself and because there are often many stakeholders in production of an IETM, there are companies that specialize in the creation of IETMs, such as O'Neil, CDG-A Boeing Company, Stotteler Henke, and Absolute Data Group [O&A03][CDG08][S1000D][S&H07][ADG09].

1.1.1 Advantages of the IETM

IETM technology touts some specific advantages over traditional documentation formats. The first and most noticeable advantage comes in its material mass and volume. The IETM is, very noticeably, the answer to the "great cost, effort, and time required to prepare, store (warehouse), distribute, and account for hundreds of tons of paper" [FUL85]. This topic does not need to be refuted too much; today a 1 Terabyte hard-drive along with a 4Ghz processor and a 32 inch monitor would easily weigh less than 40 kg and take up no more than 1 cubic meter of space – and 1 Terabyte of data is equivalent to 1,000 copies of Encyclopedia Britannica [WAB10]. Without computing the mass and volume of 1,000 copies of Encyclopedia Britannica, one can imagine the magnitude of difference.

The second and equally recognizable advantage to an IETM is speed. In comparison to paper documentation, the IETM allows for automated navigation through search-able, indexed information. This is simply not possible with large paper manuals which must be navigated with manual searching and page-turning. In practice, this means that access to the needed information can be acquired considerably faster with the use of IETMs. In one study performed by the DRTC for the AN/SPA-25D shipboard radar, 24 technicians (11 experienced and 13 inexperienced) were directed to diagnose and solve a simulated troubleshooting problem. The technicians tried out both manual delivery methods: using the NTIPS FIND (an IETM system), and using conventional methods. Half of the technicians were directed to use FIND first, the other half were directed to use paper manuals first. At the end of the study, the results showed that the resolution of the technical issues was achieved 24% faster with the IETM [LB10][FUL85]. Inexperienced technicians solved their test problems 26% faster with FIND, and experienced technicians solved the problems 22% faster. In 1984, when the Air Force conducted another study using IETMs with their joint-service radar system, they found that technicians using IETMs were able to successfully isolate faults in the system in just half of the time that it took with the conventional paper manuals [FUL85].

The IETM also makes it much easier to manage content. When producing content for paper manuals, there is difficulty in knowing if certain information has already been published in another document, and if it has, writing a reference to that information can be cumbersome (finding the referenced material, describing the location of the reference, etc.). Even in the most sophisticated and well organized paper technical manuals, the costs and the time involved in managing content are “intrinsically unsuitable” [FUL85]. On the contrary, IETMs allow simpler content management and active linking to other content that is available in a uniform content management system [LFJ03]. This allows an author to reference and display general content in multiple separate documents without having to repeat the content or force the reader to access a separate document. This is simply not possible with paper manuals. Effective re-usability is made possible only through the digitization and normalization of the content [LFJ03][FUL85]. When the Navy conducted a conversion project for two of their paper-based NAVAIR Manuals (NAVAIR 01-75PAA-2-11 and NAVAIR 01-E2AAA-2-12) to a S1000D IETM database management system, they were able to trim 1,075 pages of documentation down to 364 pages [SAN05].

Among other benefits, the IETM is also better for its ability to interact. Whereas a paper-manual cannot interact with a reader, an IETM gives readers the unique ability to see only the pertinent information based on reader input [O&A]. The added ability of interaction implies that an IETM document can be enhanced with logic (unlike a static non-responsive paper manual). Logic allows an IETM to provide instruction based on a user's needs. More evolved IETMs could potentially replace human instruction altogether. In fact, efforts have already been made to do this with military vehicle maintenance systems [LB10], and though not every IETM is built to provide this functional complexity in logic, it is important to know that one can be. [O&A03]

1.1.2 The 6 IETM Classes

The level of functional complexity to an IETM is defined by six general classes of IETMs. Organizations that produce IETMs follow this class standard in helping clients define what they currently have, and what level of IETM they require. In practice, most IETM systems fall somewhere between two classes [ADG09].

Class 0	Paper only; printed manuals	**Type I** • Descriptive or narrative support data • Repair + installation tasks • Simple tasks
Class 1	**Electronically Indexed Page Images** • Page images rather than live text • Intelligent graphics • May contain rudimentary linking within document structure	
Class 2	**Electronic Scrolling Documents** • Live text with SGML/XML tags • May include multimedia • Internal linking	
Class 3	**Linear Structured IETMs** • Utilizes SGML or XML • Most often viewed as an indexed PDF file (page turner)	
Class 4	**Hierarchically Structured IETMs** • Fully structured hierarchy of information specifically authored for the IETM • Dynamic cross-reference features • Robust search features • Data tagged with SGML/XML is stored in a relational or object-oriented database	**Type II** • Repair + installation tasks • Maintenance operational checks • Complex tasks • Fault isolation procedures (Class 5)
Class 5	**Integrated Process IETMs** Systems that go beyond providing information, but actually interact with hardware and process equipment. Provides strong: • Diagnostics • Remote Diagnostics • Intrusive Diagnostics • Expert Systems • Test Equipment • Prime Equipment Diagnostics	

Figure 1: The five IETM classes and the different types of IETMs. [ELD10]

Class 0 – Paper – These IETMs are not really IETMs. In fact, they are "conventionally printed technical manuals – paper only." [O&A03]

Class 1 – Electronically indexed page images – This indicates a digitally stored manual with electronically indexed page images. This is equivalent to the basic form of a PDF, scanned from the original hard-copy[1]. The text within these documents is still not searchable or selectable, but some Class 1 IETMs have a linked table of contents so a user can navigate to a marked spot in the document. [O&A03][ADG09]

Class 2 – Electronic Scrolling Documents – A plain-text HTML page is an example of a Class 2 IETM. It meets the requirements for a Class 1 IETM and it uses SGML tags to characterize the included text. A Class 2 also can have multimedia capabilities, but the level

[1] A PDF generated from a Microsoft® Word Document would be Class 2 because the contained text is in an SGML format.

of interaction is limited (for example: page-scrolling, hyperlinks, and document navigation buttons). [O&A03][ADG09]

Class 3 – Linear-structured IETMs – The jump from a Class 2 IETM to a Class 3 is quite vague but the differences do exist. A class 3 IETM still follows a linear format, but the underlying information is stored as SGML/XML tags and the information is indexed for quick access [O&A03]. A Class 3 IETM can also be distinguished from a Class 2 in its presentation of information. A Class 3 has a step-by-step oriented presentation that is easier to comprehend and follow. “The document is structured more freely following the logic of the content” [ADG09].

Class 4 – Hierarchically Structured IETMs – Information is stored as SGML/XML in content modules, in such a way that there is minimal data redundancy and high data integrity [ADG09]. The content is parsed and presented using dialogs and cross-referenced information from the content and metadata of the SGML. The key to a Class 4 is the ability to present information seamlessly without content redundancy or ambiguity. For a simple example: changing the oil in a car is a fairly uniform procedure for all cars. There are only a few minor differences, like the location of the oil dipstick, where to find the drain plug, or how much oil will be needed to replace the old motor oil. In the case where a Class 3 would have separate dialogues for each car, a Class 4 would have one main dialogue with context-driven content in places where there are differences between cars.

Class 5 – Integrated Process IETMs – Class 5 IETMs are defined by having the ability to let the manual interact (generally with prognostic and diagnostic interfaces and sensors) with the different resources needed to successfully complete a task. They often involve the implementation of expert systems, integration with test equipment and diagnostic tools, and sophisticated logic processing [O&A03][ADG09]. O’Neil & Associates is one of the companies that provide Class 5 IETM implementations. In their Interactive Electronic Maintenance System (EMS), the IETMs are designed to aid personnel in quickly and effectively repairing parts on military vehicles and aircraft [O&A03]. These manuals have the ability to not only provide instructions on how to conduct a repair for specific machinery but also how to order new parts and perform diagnostic tests on the machinery. Development of a Class 5 IETM is highly specialized and can be very expensive but extremely cost-effective by decreasing failure incidence and increasing the time in service for platforms [CDG10].

1.1.3 Teaching Techniques

Before discussing the use of the IETM in the classroom, it is important to discuss what the traditionally used reference materials are for instruction in college classrooms. The most notably used options for media learning are flash video, web-pages, and slide-shows [UOP10][UWO10][UWP10], but there are myriads of other options available. The following section discusses the strengths and weaknesses of the various teaching techniques available for today's classrooms.

1.1.3.1 *Slide-shows*

Slide-shows (or PowerPoint® slides) are a widely used method for teaching students step-by-step processes [CMU10][UWO10][UWP10]. Microsoft PowerPoint® is used to create rich presentations with very little training. Studies have shown that audiences retain more from presentations that use visual aids, and PowerPoint® is specifically designed for this capability [KAM03]. The original intent of a PowerPoint® is also its drawback: because PowerPoint® Slides are not particularly designed for conveying textual or highly technical information [KAM03]. They are also not designed for decisional display – though it is possible to create presentations with complex navigation between slides, it is not practical. Thus, PowerPoint® slides, and similar presentation tools, are not intended as instructional tools, but rather as presentational aides.

1.1.3.2 *Web Page*

A Web page enhances the presentation of media by providing non-linear-path content. The possibilities with HTML are virtually endless as to what an author can include, and with the help of CSS and JavaScript, an author can create an interactive learning web-page for virtually any user. There have been a number of articles declaring the equivalent or better effectiveness of web-based instruction in comparison to classroom instruction [WEL03][COO07][LOC02]. One of the more thorough studies, a meta-analysis conducted by the United States Army, concluded that web-based learning was 6% more effective than classroom instruction for teaching declarative knowledge[2] [SIT06]. The analysis also showed with 95% confidence that when web-based learning was used to supplement classroom instruction (in comparison to classroom instruction without the aid of web-based learning), it was 13% more effective for teaching declarative knowledge and 20% more effective in teaching procedural knowledge[3] [SIT06].

However, the inherent disadvantage to using web-pages for instruction is the initial cost, time, and skill required to create an effective learning environment. The construction of a website with a sufficient knowledge base, and the capacity to present the contained knowledge in an orderly and understandable way is highly dependent on the technical capacities of the author(s). Because of this, many web pages are often subject to poor instructional design [COO07].

1.1.3.3 *Flash*

To provide a user with rich, interactive content display in a web page, Adobe® Flash® is arguably the best choice [DLL09][ADO+10]. Flash is especially useful for presenting streaming video, and 3D content [DLL09][ADO+10][FLASH]. Flash® has been a subject of debate during the last few years. In 2009 and 2010, Apple announced restriction of flash on its mobile and tablature devices, with the argument that it is a “CPU Hog”, there are numerous reliability and security issues, and that its proprietary nature threatens the nature of

[2] Declarative knowledge is used here to describe the retention of factual information and principles.
[3] Procedural knowledge is used here to describe the retention of procedural information or step-by-step processes.

“Open Web” design [OZE10][JOB10][4]. Another issue to consider is whether or not animation and interactive 3D content is effective in enhancing learning. Many researchers have failed to prove the superiority of animation over static depiction of graphics, saying that the use of animation in learning needs to be well justified, well-designed, and well-supported [LOW04]. These demands make the use of graphical animation costly, limited, and highly specialized.

1.1.3.4 eLearning Software

Lectora Inspire is an HTML-based e-learning development software. It is an intuitive and comprehensive tool set used for creating presentations and interactive learning media. The cost is approximately $2500 for a user license and a free trial is available (http://www.trivantis.com/uk/free-trial-downloads). When publishing the final product of a developed 'title' to the browser, the foundation of the presented material is stored as HTML with JavaScript and CSS. The tool set also allows for the insertion of links to media and embedded flash video and Shockwave animations. Lectora Inspire uses a slide-show-based approach to presenting material, like many of the eLearning tools on the market. SumTotal ToolBook is another HTML-based e-learning development software similar to Lectora. Without maintenance or support, it can be purchased for less than $1300 (http://www.sumtotalsystems.com/products/toolbook-elearning-content.html). There are many other authoring tools to choose from [CLP11].

MyUdutu is a free, award-winning, option for an online eLearning development tool [UDU**]. It offers a slide-show-like presentation with the possibility of 'scenarios'. These scenarios are used to create decision paths – which are different results based upon user input.

When testing MyUdutu, there were some small issues with the production of the final product. Sometimes the generated HTML did not display consistently between browsers. In other instances the generated HTML failed to load. After some closer inspection, it was found that MyUdutu uses a mix of Javascript, Flash, and CSS to achieve the effects and smooth navigation. The final product, if hosted by an independent server, worked in Internet Explorer and Mozilla Firefox. It seems the only drawback would be the dependence on Flash to present the final product, and even this does not seem to be much of a drawback – Adobe claims that Flash is available for 99% of internet-enabled desktops in “mature” markets [ADO10].

The common approach taken by all eLearning software is that of the slide-based presentation. This may very well be the most effective way to present a step-by-step learning material. However it does not offer the user a chance to see a collection of the content all in one place. The solution to this is an explorer window for navigating the learning material. This is a standard procedure for all of the eLearning tools that were reviewed. The IETM takes a similar explorer approach with one difference – the content is presented in one scrollable window rather than a slide-based form.

[4] These statements are highly debatable with more recent releases of Flash® [OZE10]

1.1.3.5 Human Instruction

The most obvious and most traditional approach to teaching is basic human instruction. This has been the tried and true method for millennia – dating back to Shanyang in the Yu period of 2257-2208 BC [BUM10]. Recently, over the past five decades, instructors have been quickly adapting to the accompaniment of digital media in their classrooms [MUR08]. The specific role that an instructor plays, even when surrounded by digital technology, is the unique ability to respond to questions and engage the learner in a way that software has not been able to do. Research previously done by Kulik and Kulik on computer-aided instruction showed that students learned better when instruction was supplemented with computer-based reference materials. However, the studies were not able to show consistent benefits from standalone computer-based instruction [KUL91]. So, even with brilliant ideas in the technology market, human instruction proves to be important to successful education, and it can be ameliorated with the aid of computer-based instructional materials.

1.1.3.6 Teaching Techniques Summary

There are countless numbers of different teaching techniques that have been and are still used today. Each teaching technique has advantages and disadvantages. Often the relative effectiveness of these techniques is heavily influenced by the time, effort, and cost required in implementing them [COO07]. Measuring their cost-effectiveness is a difficult and sensitive subject that this thesis has not addressed entirely. This is an important deciding factor in choosing a teaching technique that merits more research. Yet, to support that the IETM is an effective and justifiable teaching tool, the considerations of time and effort still must be considered.

2 Method

2.1 The GE 1030 Class

2.1.1 Purpose of the class

The General Engineering (GE) 1030 course at University of Wisconsin – Platteville, Introduction to Engineering Projects, is designed for new engineering students to see a variety of the different fields of engineering and actively participate in some of the coursework for each field. The Software Engineering (SE) Module of the GE 1030 course uses Alice to give the students a fun introduction to the basics of software engineering in an interactive virtual environment.

2.1.2 Programming in Alice

Alice is a 3D programming environment designed to make it easy to create interactive animations or stories. It is especially useful in teaching beginners the most important concepts of object-oriented programming, functions, methods, variables, events [MOS00].

Alice was created by Carnegie Mellon University's School of Computer Science. It started as a prototype for head-mounted virtual display before it was considered for the Alice program that it is today [ALI99]. It was realized that the virtual world could be used to actively show beginning programmers the results of their programming efforts. Over time, a team of faculty and senior students have committed to building the Alice programming environment into what it is now. Because Alice can be difficult for those who have never done programming before, hundreds of middle schools, high schools, and colleges have offered instructional courses on programming in Alice [ALI99].

2.1.3 How Alice Was Taught

In the GE 1030 SE Module, students learned Alice directly from their course instructor within the allotted four hours of lab/lecture for the GE 1030 SE Module. The instructor spent about 15 minutes of time stating the requirements of the Alice assignment (described in the following section) and 45 cumulative minutes teaching the basic procedure for using the Alice programming environment. The concepts were divided up throughout the first two-hour session of class; a concept was introduced and the students then immediately had time to work on the learned concepts in groups. The concepts introduced were creating a new Alice program, adding objects and characters to the Alice world, creating and using dummy objects[5], and moving individual body parts of a character or object. During the second two-hour session, approximately 15 minutes were used to explain the basics of scene changing[6]. Students had a total of approximately 2.5 hours of dedicated lab time to work in groups on the programming assignment, and they were urged to ask the instructor questions on an as-needed basis. One instructor was shared amongst approximately 30 students, so there were

[5] Dummy objects are invisible to the camera, and are used to save the position and orientation of a character or object within the Alice world. This allows one to move objects to pre-determined positions during the runtime of the Alice program.

[6] These numbers are only approximations because the times varied between each section. This is discussed in the conclusions as a potential weakness of the study.

times when the students had to wait for the instructor to finish answering questions for another group. In order to minimize the waiting time, students were given links to online Alice PowerPoint® tutorials or access to the Alice IETM so that they could investigate issues without the instructor. Students were informed where to find the reference materials at the beginning of the first day of class.

2.1.4 Class Assignment

As an assignment for the SE Module, students were required to work in groups of 3 or 4 persons to develop an Alice Program that satisfied a list of requirements [HAS10]. The students were expected to complete the assignment within three weeks after the start of the GE 1030 SE module. The requirements are listed and described below:

1. The World shall contain at least 3 scenes.

   A 'scene' is meant as a change of the position of the camera, characters, props, and environment to create a recognizable change in story context and setting. A scene does not necessarily need to have a transitional effect (such as the fade out to black and fade in used in production films).

2. One of the scenes shall contain at least two characters who engage in a dialog. A sample dialog might be

   - Character 1: What is your favorite engineering discipline?
   - Character 2: (Your answer)
   - Character 1: Why do you like that discipline?
   - Character 2: (Explains why)
   - Character 1: Where did you learn about [name of discipline]?
   - Character 2: (Response)

- You can use a different dialog instead, but it needs to be engineering-related and involve at least 3 questions with responses.

A 'character' is meant to be a person, animal, or other object that is part of the story within the Alice program. A 'dialogue' is meant to be either a textual or audio conversation between characters. A textual dialogue can be created using Alice's built-in 'say' and 'think' commands that are inherited by every Alice object. An audio dialogue can be similarly created using the built-in 'play sound' command.

3. In each scene, the world shall contain at least 1 building, 2 characters, and 3 props (trees, flowers, hockey pucks, skateboards, cell phones, aircraft carriers, etc.).

Alice includes a gallery of buildings, characters, and props within the provided 'Local Gallery'. The above requirement is satisfied by having each scene contain the minimum amount of objects. Buildings characters and props can be re-used in different scenes.

4. Two characters shall each move to at least three new places.

Alice objects contain a series of built-in move commands such as 'move', 'move to', 'move toward', and 'move away from' to achieve object movement around virtual 3D Alice world. A 'new place' is meant to be a previously unvisited location within the Alice world by a given character.

5. Two characters shall move parts. For each character, there must be three body parts moved with each part having at least three movements.

Objects in Alice are aggregations of ‘parts’ and ‘subparts’ that can behave as individual Alice objects. A ‘character’ is assumed to be a human or animal with body parts. To satisfy the above requirement, at least two characters must have three subparts (such as an arm, leg, head, finger, or foot) that implement movement commands. Each of these subparts must implement at least three separate movement commands (such as a rotation, roll, turn, or movement). Alice has some characters and objects with pre-fabricated subpart movement. These pre-fabricated movements do not count toward the satisfaction of the requirement.

6. At least one scene shall contain an Alice vehicle - something that carries another object. The carried object must enter the vehicle in one scene and leave the vehicle in that or some later scene.

All Alice objects contain a ‘vehicle’ property, which can be set statically or during runtime to refer to any other object or subpart within the Alice world. An object’s movement tied to the movement of its vehicle whenever the vehicle moves. For example: a character’s vehicle property can be set to a skateboard object, so whenever the skateboard moves, the character will move with it. The character’s vehicle can also be changed to the default ‘world’ object which cannot move. The requirement is satisfied by changing an object’s vehicle property during run-time, moving the vehicle, and changing the object’s vehicle property again after the move.

7. Within one or more scenes, there shall be at least two camera changes to both new positions and new angles. Each of the angle/position pairs must be distinct from the others.

The ‘camera’ object is the dynamic viewing perspective in the Alice world. The camera can be moved and oriented just as any other Alice object. To satisfy the requirement the camera must be moved at least two times during a scene to a new location and orientation, such that the view of the world is distinctly changed. A ‘distinct’ angle/position pair is meant to be a movement and orientation that create a unique viewpoint of the 3D world apart from the other required camera positioning.

8. There shall be at least two additional, team-selected, significant features such as events, scene fades, or sounds.

The Alice programming environment has numerous features not covered by the requirements. ‘Events’ are actions that happen in response to a given incident (such as a mouse-click, a key-press, or the satisfaction of a conditional statement). ‘Scene fades’ are transitional effects for scene-changing that can be implemented by changing the camera’s and the world’s lighting properties. Other features include the use of ‘functions’ (which are methods that return a value), ‘Do together’ blocks (which allow multiple commands to happen simultaneously), ‘Loops’, ‘Do In Order’ blocks (used to sequentially perform commands within ‘Do Together’ blocks).

2.2 Description of Class Reference Materials

2.2.1 Original PowerPoints used in the past

2.2.1.1 Access

The original PowerPoint reference materials come from several places. The course instructor had hand-picked about ten materials that are particularly useful in completing the requirements for the assignment. These are links to other PowerPoint slides or web pages that detail a specific Alice topic [HAS10][ALI99]:

A set of basic getting started tutorials: http://alice.org/index.php?page=tutorials/tutorials
A forum for asking questions to other Alice users:
http://www.alice.org/community/showthread.php?t=1342
A set of PowerPoint tutorials from Duke University:
http://www.cs.duke.edu/csed/alice09/tutorials.php

2.2.1.2 Content

Alice reference materials include basic PowerPoint tutorials with step-by-step examples for implementing a particular feature in Alice. The vast majority of the referenced materials are provided as concept tutorials on the Duke University Alice Summer Workshop website [http://www.cs.duke.edu/csed/alice09/tutorials.php]. The tutorials were created for summer workshops given to teach middle-school and high-school students programming concepts using Alice. The tutorials include the PowerPoint slides, and slide handouts designed for teachers to present the material in the workshops. They were not necessarily intended for college-level students.

The tutorials were designed to be followed from start to finish. The estimated time for completing tutorials can range from 15 minutes up to 1.5 hours. Topics for these tutorials include, but are not limited to, the essentials to creating a world in Alice, adding objects, setting up a scene, writing new methods, camera control, creating events, changing properties, importing images, and using if/else statements. For the majority of the Duke Alice tutorials that take more than 30 minutes to complete, topics were grouped and presented together in a single PowerPoint. For example: Duke University provides a four-part tutorial (four separate PowerPoints) on adding objects, setting up scenes, writing methods, camera control, and events [LIA10]. The suggested time is 45 minutes per part.

TABLE 1 SHOWS THE NUMBER OF SLIDES DEVOTED TO A SPECIFIC ALICE TOPIC FOR THE PRINCESS & DRAGON 4-PART TUTORIAL [LIA10].

Topic Covered	**Part 1**	**Part 2**	**Part 3**	**Part 4**
Adding 3D Text				2
Adding comments		1		
Adding objects	3		1	
Adding sound				3
Animating objects		13	11	1
Browsing the object gallery	1			1
Calling your created method		2		
Copying a method	3			
Creating a method	1	4		1
Creating a world	1		1	
Distinguishing between world/object methods		1		
Explaining the Alice screen layout	1			
Finding the center of an object	2			
How to affect subparts of an object	3			
Moving methods within the editor				
Performing instructions as seen by another object		1		
Playing the world (testing animation, sound, and events)	1	3	1	2
Positioning objects	4		2	1
Positioning the camera	2		1	
Renaming objects	1			
Saving a world	1			
Setting the duration of an instruction	1			
Setting the point of view of the camera		2	2	
Using ‘do in order’ blocks	2			
Using ‘do together’ blocks	1			
Using ‘loop’ instructions		2		
Using ‘wait’ instructions				1
Using Billboard objects (positioning and animating)				5
Using dummy objects	1	1	2	
Using editor tabs in the Alice screen layout		1		
Using events (mouse-click or key-press)			1	1
Using functions (conditional instructions)			3	1
Using pre-made methods	1			
Using the ‘color’ property of an object		2		
Using the ‘isShowing’ property of an object				1
Using the ‘move’ method of an object	1			
Using the ‘quad view’	3			
Using the ‘turn’ method of an object		1		
Using the ‘vehicle’ property of an object		2	2	
Total	**34**	**36**	**27**	**20**

The first part includes a total of 37 slides, covering 20 different generalized Alice concepts. The second part includes a total of 39 slides covering 14 unique concepts[7]. Part 3 has 32 slides with 11 unique topics. Part 4 has 22 slides with 12 unique topics. The tutorials can be found at [http://www.cs.duke.edu/csed/alice09/tutorials.php#gettingStarted].

[7] Individual ‘properties’ and ‘methods’ are listed as topics but they are not considered unique concepts.

2.2.2 IETM used in Experiment.

2.2.2.1 Access

The Alice IETM was accessed via a website: [http://www.blackstrype.com/tivit]. One can load the IETM content by clicking a link to a specific tutorial from the main menu, or by clicking a link to an IETM module referenced within the content. One can access supporting content by clicking a link which loads within the current document. One can access external content in the same way. Information on the different topics of Alice can be found in the 'frequently asked questions' dialog (automatically loaded on the first visit to the page), or by choosing an IETM Module from the list of topics.

2.2.2.2 Content

The Alice IETM was produced specifically for the students of the SE Module of the GE 1030 class. The IETM included step-by-step procedures, pictures, videos, and links to supporting content. Each IETM module was dedicated to a specific Alice topic, such as implementing a scene-change, or positioning objects. Interconnecting topics could be accessed via links to other modules -- content that is loaded into the current document upon user-request. An example of an IETM module would be as follows:

A tutorial for implementing a scene-change includes a step-by-step procedure with pictures for each step involved in scene-changing. Scene-changing requires knowledge of other concepts such as using dummies, or changing the camera view. A user is be able to request supplementary content for more detailed explanations on changing the camera view, and using dummies by loading IETM modules into the current document.

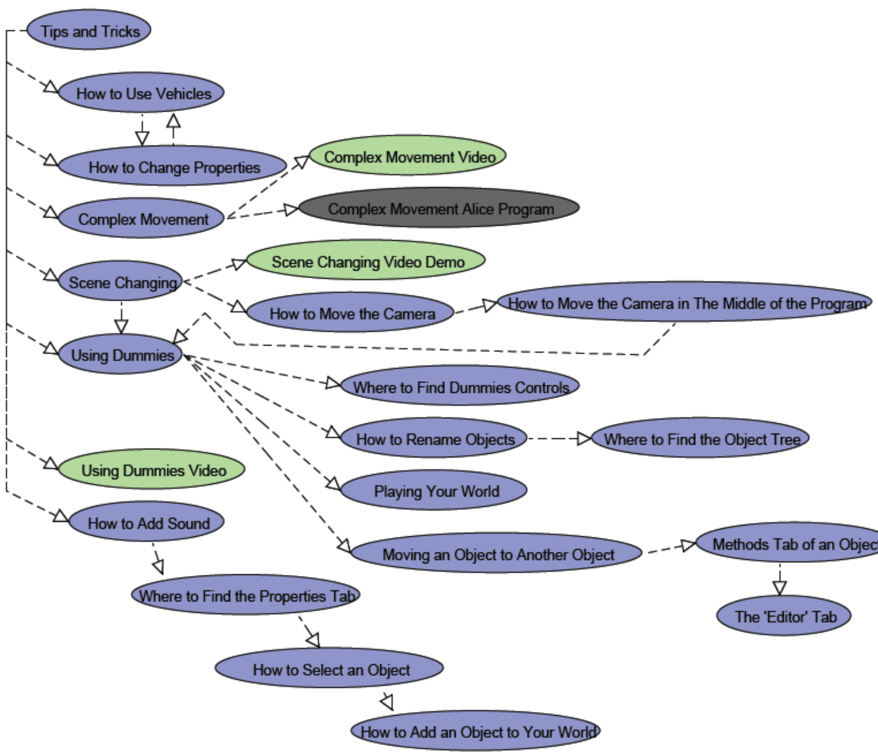

FIGURE 2 AN EXAMPLE OF IETM MODULE BREAKDOWN IN THE TIPS AND TRICKS IETM

By using IETM modules to display content, every student viewed the same IETM, but the specific content accessed was tailored to the needs of the particular student.

2.3 The study

2.3.1 Method for Review

2.3.1.1 Scientific Control Study

The GE 1030 SE Module was taught between four different sections. Two of the sections, the control group, were directed to use the PowerPoint reference materials and the other two sections, the experimental group, were directed to use the Alice IETM as their reference materials. At the end of each two week section, each group was given a survey. The survey was designed to collect student ratings of the reference materials they used in terms of usability and understandability. The survey also included questions asking the students to estimate the amount of time required to complete different parts of the assignment, as well as the total number hours spent completing the assignment. The students were asked to return the surveys to the instructor at the end of the last class period. See Appendix A for the survey.

2.3.1.2 Observing the Students

The students who used the PowerPoint reference materials were not aware of the IETM, and vice versa. The goal of this nondisclosure was to minimize the possibility of the students providing a biased opinion on the survey of the reference materials. Students were informed that they would have someone attending the class to observe and take notes on improving the instructional tools of the class. For each section, data were collected on the types of questions students asked, by whom, and how much time was spent addressing the questions (either by answering the question or by guiding the students to the reference materials). The information that was collected can be seen in the Appendix B .

As well as observing the students, for the sections that used the IETM, usage statistics were collected for the website that hosted the Alice IETM. The usage statistics show how often the IETM users accessed the reference materials, and which resources were accessed. The usage statistics can be found in the Appendix D .

3 Results

3.1 Survey Results

The following is a breakdown of the results gathered from the group surveys. Students were asked to rate how understandable and how useful the reference materials were. They were also asked to estimate how long it took to complete specific tasks in Alice, and how many total hours they spent on the assignment. The student groups who used the IETM (Sections 3 and 4) as their reference materials were expected to rate their materials more favorably than those using the PowerPoint slides (Sections 1 and 2). They were also expected to spend less time on their assignments.

The two-sample t-tests showed that there was no substantial evidence that the IETM satisfied any of the above predictions. The students using the Alice IETM did not rate the reference materials significantly different from the students using the PowerPoint slides in terms of understandability, usefulness, nor completion time. The results are broken down based on the analysis of each survey item.

3.1.1 Understandability

The null hypothesis is that there is no significant difference in ratings for understandability between the experimental group, those using the IETM, and the control group, those using the PowerPoint slides. The null hypothesis was tested to see if this difference exists.

Survey Results for Rated Understandability

	Mean	N	Standard Deviation
IETM (Sections 3 & 4)	2.294	17	1.2127
PowerPoint (Sections 1 & 2)	2.316	19	0.8852

	Degrees of Freedom	CI for Difference (95%)	t-value	p-value
Null Hypothesis (No Difference)	34	(-0.753, 0.709)	-0.0616	0.9514

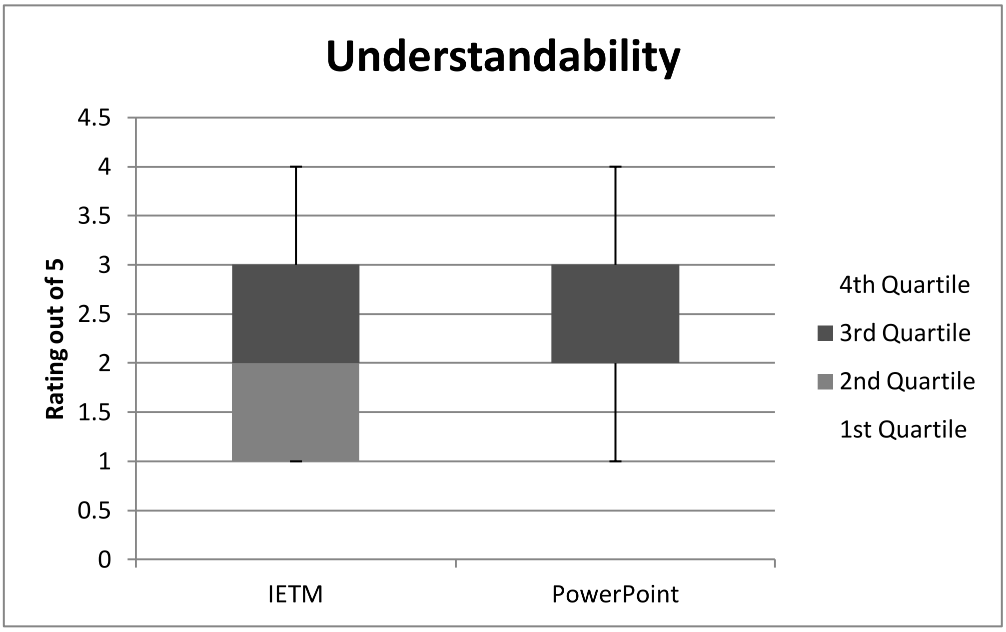

FIGURE 3 BOXPLOT OF RATINGS FOR UNDERSTANDABILITY BETWEEN IETMS AND POWERPOINTS.

3.1.2 Null Hypothesis Remains: No difference in Understandability

The results indicate that there is no statistically significant difference in ratings for understandability between the experimental and control groups. Thus, the null hypothesis cannot be rejected.

3.1.3 Usefulness

The null hypothesis is that there is no significant difference in ratings for usefulness between the experimental group, those using the IETM, and the control group, those using the PowerPoint slides. The null hypothesis was tested to see if this difference exists.

Survey Results for Rated Usefulness

	Mean	N	Standard Deviation
IETM (Sections 3 & 4)	2.412	17	0.7123
PowerPoint (Sections 1 & 2)	2.474	19	0.7723

Null Hypothesis (No Difference)	Degrees of Freedom	CI for Difference (95%)	t-value	p-value
	34	(-0.5655, 0.4415)	-0.2505	0.8038

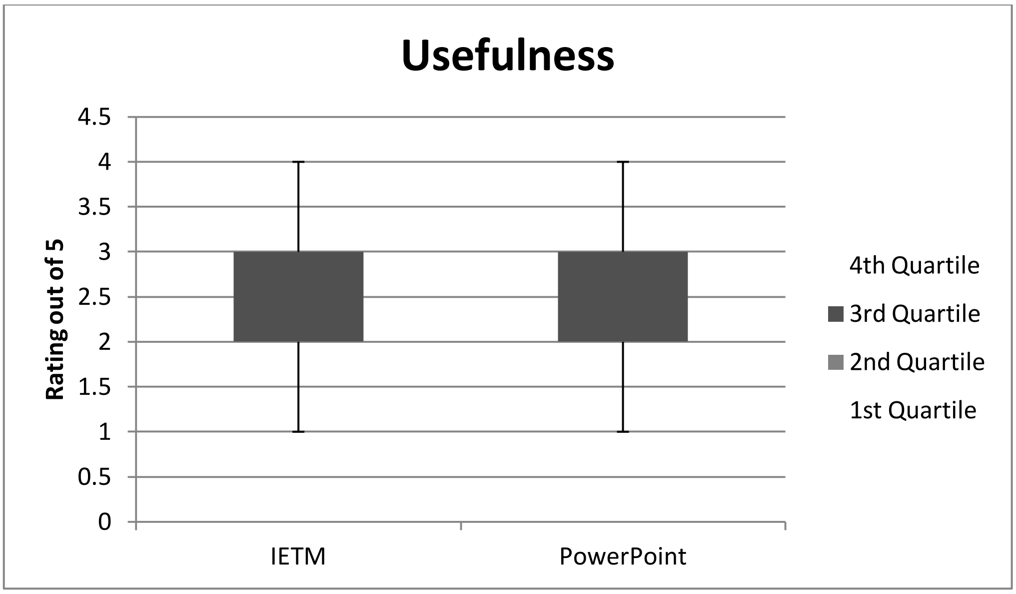

FIGURE 4 BOXPLOT OF RATINGS FOR USEFULNESS BETWEEN IETMS AND POWERPOINTS.

3.1.4 Null Hypothesis Remains: No difference in Usefulness

The results indicate that there is no statistically significant difference in ratings for usefulness between the experimental and control groups. Thus, the null hypothesis cannot be rejected.

3.1.5 Time Spent Scene Changing

The null hypothesis is that there is no significant difference in the amount of time spent implementing scene changes between the experimental group, those using the IETM, and the control group, those using the PowerPoint slides. The null hypothesis was tested to see if this difference exists.

Survey Results for Time Spent Implementing Scene Changes

	Mean	N	Standard Deviation
IETM (Sections 3 & 4)	9.588	17	9.0178
PowerPoint (Sections 1 & 2)	8.75	19	4.7177

	Degrees of Freedom	CI for Difference (95%)	t-value	p-value
Null Hypothesis (No Difference)	34	(-4.2102 , 5.8862)	0.3434	0.7344

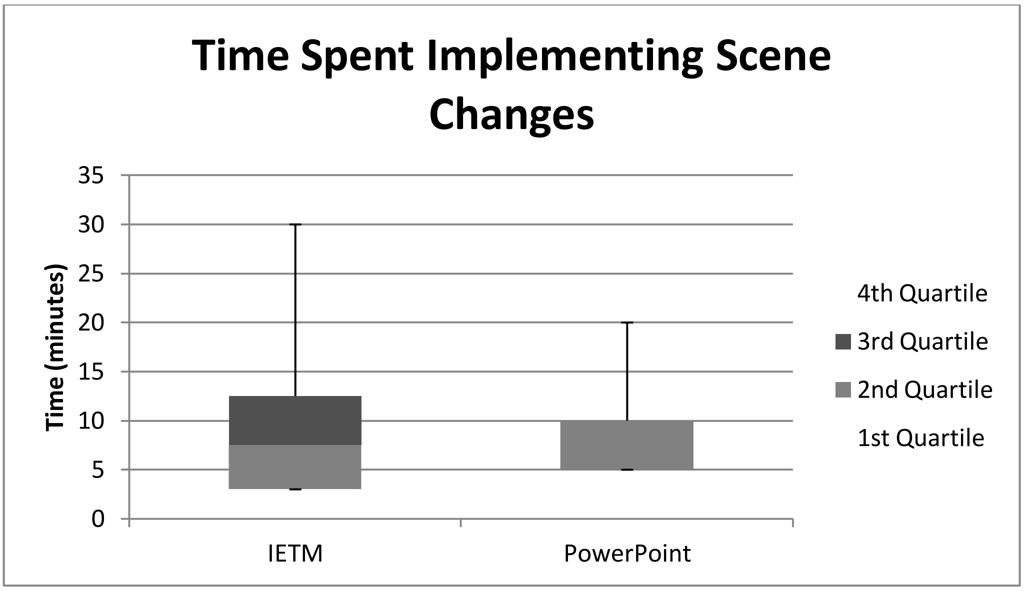

FIGURE 5 BOXPLOT OF DECLARED TIME SPENT IMPLEMENTING SCENE CHANGES BETWEEN IETMS AND POWERPOINTS.

3.1.6 Null Hypothesis Remains: No difference in Time Spent Scene-Changing

The results indicate that there is no statistically significant difference in the amount of time spent implementing scene changes between the experimental and control groups. Thus, the null hypothesis cannot be rejected.

3.1.7 Time Spent Using Alice Vehicles

The null hypothesis is that there is no significant difference in the amount of time spent implementing vehicles between the experimental group, those using the IETM, and the control group, those using the PowerPoint slides. The null hypothesis was tested to see if this difference exists.

Survey Results for Time Spent Using Alice Vehicles

	Mean	N	Standard Deviation
IETM (Sections 3 & 4)	7.912	17	5.6741
PowerPoint (Sections 1 & 2)	4.258	19	2.5868

	Degrees of Freedom	CI for Difference (95%)	t-value	p-value
Null Hypothesis (No Difference)	34	(0.5373 , 6.7707)	2.4381	0.0238

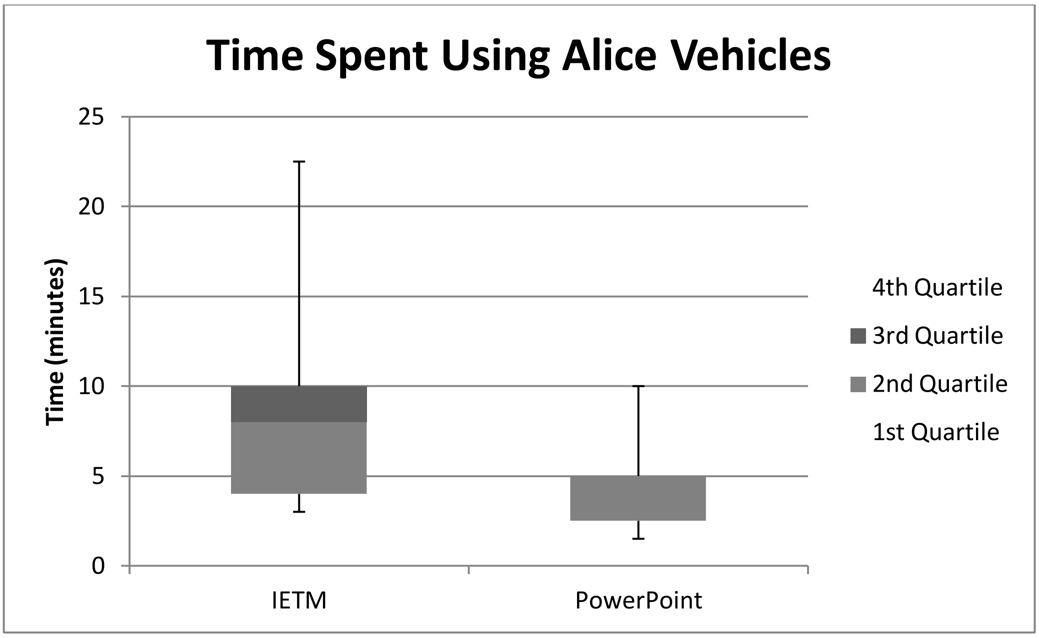

FIGURE 6 BOXPLOT OF DECLARED TIME SPENT IMPLEMENTING ALICE VEHICLES BETWEEN IETMS AND POWERPOINTS.

3.1.8 Null Hypothesis Rejected: Difference exists in Time Spent Using Vehicles

The results indicate that there is a statistically significant difference in the amount of time spent implementing vehicles between the experimental and control groups. Thus, the null hypothesis can be rejected. The results show that students spent less time using Alice Vehicles when they were provided PowerPoint slides as reference materials.

3.1.9 Time Spent Positioning Objects

The null hypothesis is that there is no significant difference in the amount of time students spent positioning objects between the experimental group, those using the IETM, and the control group, those using the PowerPoint slides. The null hypothesis was tested to see if this difference exists.

Survey Results for Time Spent Positioning Objects

	Mean	N	Standard Deviation
IETM (Sections 3 & 4)	3.379	17	2.8849
PowerPoint (Sections 1 & 2)	4.008	19	4.7916

Null Hypothesis (No Difference)	Degrees of Freedom	CI for Difference (95%)	t-value	p-value
	34	(-3.2941 , 2.0361)	-0.4827	0.633

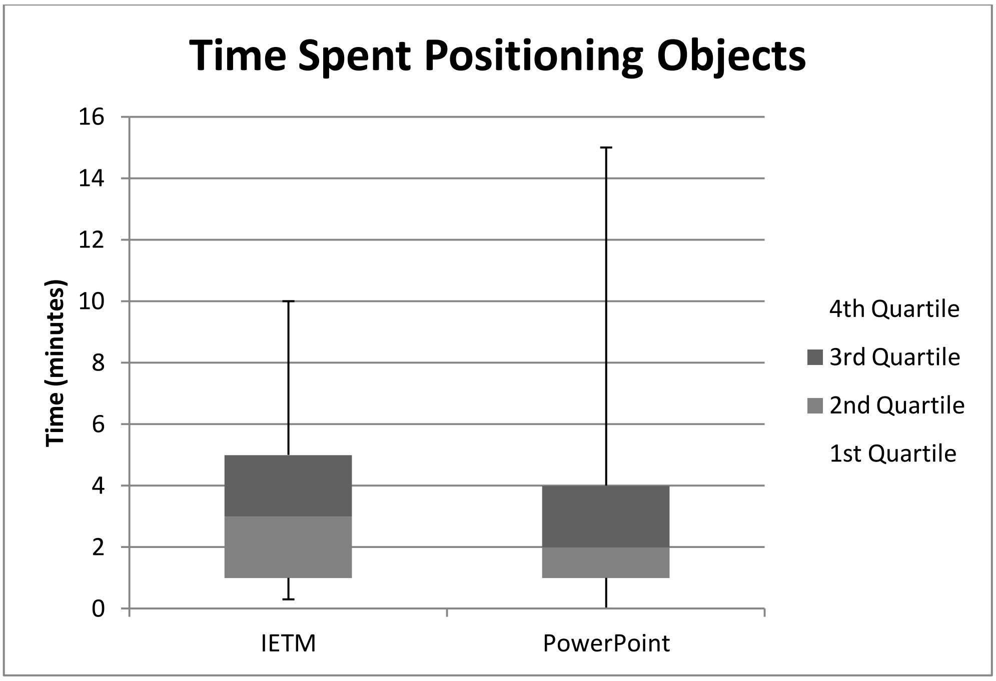

FIGURE 7 BOXPLOT OF DECLARED TIME SPENT POSITIONING OBJECTS BETWEEN IETMS AND POWERPOINTS.

3.1.10 Null Hypothesis Remains: No difference in Time Spent Positioning Objects

The results indicate that there is not a statistically significant difference in the amount of time students spent positioning objects between the experimental and control groups. Thus, the null hypothesis cannot be rejected.

3.1.11 Total Hours Spent

The null hypothesis is that there is no significant difference in the total hours students spent completing the assignment between the experimental group, those using the IETM, and the control group, those using the PowerPoint slides. The null hypothesis was tested to see if this difference exists.

Survey Results for Total Hours Spent

	Mean	N	Standard Deviation
IETM (Sections 3 & 4)	3.603	17	1.714
PowerPoint (Sections 1 & 2)	4.276	19	1.995

	Degrees of Freedom	CI for Difference (95%)	t-value	p-value
Null Hypothesis (No Difference)	34	(-1.9307 , 0.5847)	-1.0886	0.2842

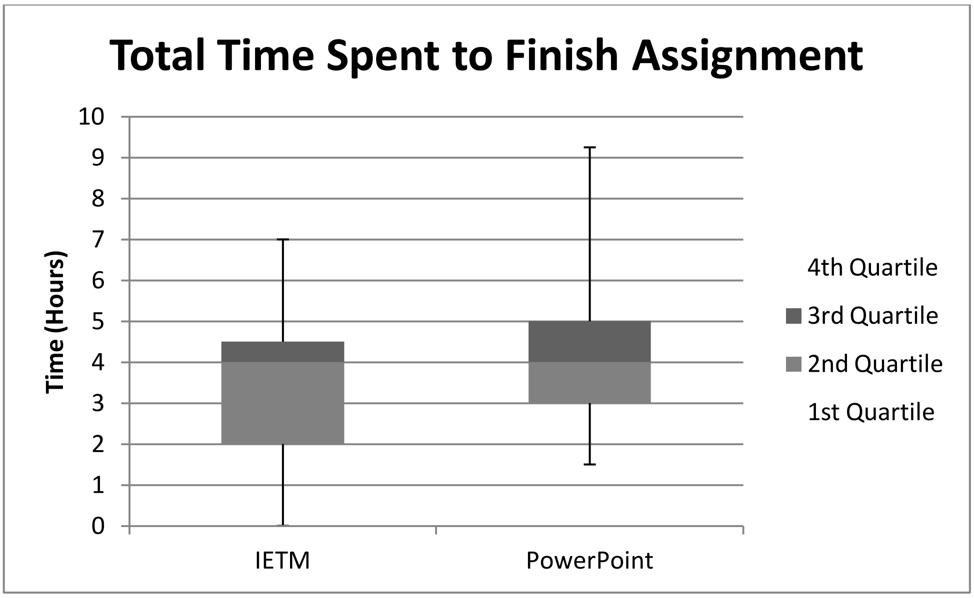

FIGURE 8 BOXPLOT SHOWING DECLARED TOTAL TIME SPENT TO FINISH THE ALICE ASSIGNMENT BETWEEN IETMS AND POWERPOINTS.

3.1.12 Null Hypothesis Remains: No difference in Total Hours Spent

The results indicate that there is not a statistically significant difference in the total hours students spent completing the assignment between the experimental and control groups. Thus, the null hypothesis cannot be rejected.

3.2 Class Observation Results

The following is a breakdown of the results gathered from the class observations. For each section, the class was observed to see how much time was spent addressing questions relating to the Alice assignment (see Observing the Students). The student groups who used the Alice IETM as their reference materials (Sections 3 and 4) were expected spend less time resolving questions than those using the PowerPoint slides (Sections 1 and 2).

The two-sample t-tests showed that there is evidence that the IETM satisfied the above predictions. The students using the IETM spent significantly less time asking questions than the students using the PowerPoint slides. The results of the class observations are provided below.

3.2.1 Time Spent Asking Questions

The null hypothesis is that there is a measurable difference in the amount of time spent asking questions between the experimental group, those using the IETM, and the control group, those using the PowerPoint slides. The null hypothesis was tested to see if this difference exists.

Observed Results for Time Spent Addressing Questions			
	Mean	**N**	**Standard Deviation**
IETM (Sections 3 & 4)	1.955	20	1.8093
PowerPoint (Sections 1 & 2)	7.275	20	6.5904

	Degrees of Freedom	**CI for Difference (95%)**	**t-value**	**p-value**
Null Hypothesis (No Difference)	38	(-8.4137 , -2.2263)	-3.4813	0.0012

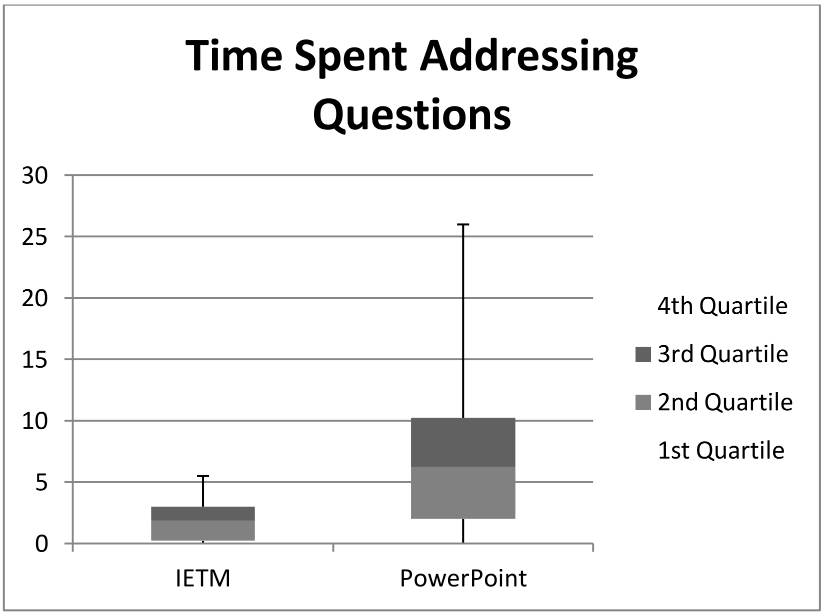

FIGURE 9 BOXPLOT DECLARED TIME SPENT ADDRESSING QUESTIONS BETWEEN SECTIONS USING IETM AND SECTIONS USING POWERPOINTS.

3.2.2 Null Hypothesis Rejected: Difference exists in Time Spent Asking Questions

The results indicate that there is a statistically significant difference in the amount of time students spent asking questions between the experimental and control groups. Thus, the null hypothesis can be rejected. The results suggest that students using the Alice IETM will spend an average of 5 minutes less time asking questions than students given PowerPoint slides as reference materials.

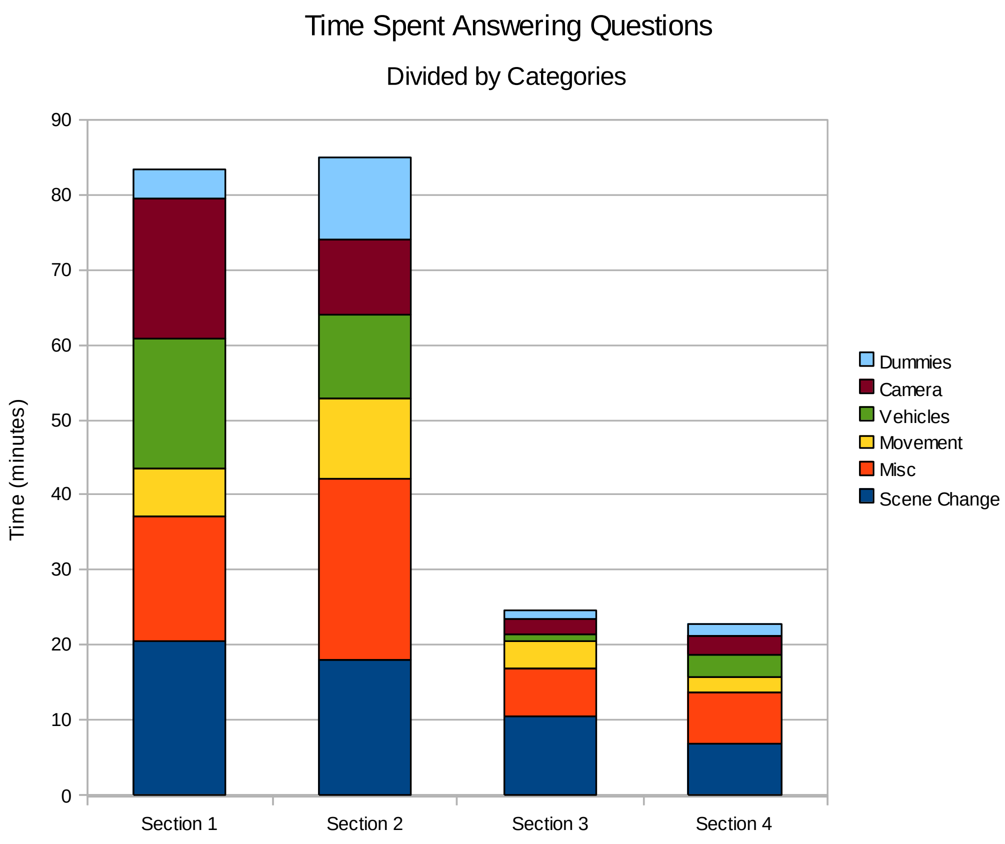

FIGURE 10 STACKED CHART SHOWING THE COLLECTIVE TIME SPENT ANSWERING QUESTIONS PER SECTION (DIVIDED BY CATEGORY). SECTIONS USING THE POWERPOINT SLIDES SPENT CLOSE TO ONE HOUR MORE HAVING THEIR QUESTIONS ANSWERED.

This means that, for a class of 30 students (ten groups), instructors could save up to 42 minutes (a minimum of 11 minutes) per class-period by using the Alice IETM instead of the PowerPoint slides. In this particular study, IETM users collectively spent close to an hour less time asking questions to the instructor than did PowerPoint users.

3.3 Usage Statics for Alice IETM Website

Usage statistics were collected from blackstrype.com/ - the hosting site for the Alice IETM – to measure the access to the IETMs for Section 3 and Section 4. The graphs and the tables below summarize the daily and hourly site usage for the month of November 2010. The full collection of the November usage statistics can be found in Appendix D

The usage results indicate that students were accessing and downloading the IETMs mostly during the hours of the class[8] [9] [10] [11]. Groups in Section 3 made up for 42.82% of the hits to blackstrype.com during the month of November, while groups in Section 4 made up for 27.00% of the hits. It should also be noted that 94.89% of all downloaded content was requested during the days of class for Section 4, and that 93.24% of all downloaded material

[8] 60.62% of the website hits occurred between 9:00 and 11:00 in the morning.
[9] 81.82% of the website hits came from a UW-Platteville hostname or IP address.
[10] 69.82% of the website hits occurred on the 3rd, 10th, 17th, and 24th.
[11] 98.11% of the blackstrype,com content was downloaded between 9:00 and 11:00 in the morning.

was due to requests for firstSceneChangeDemo.avi and dummies_video.avi (two large, AVI video files associated with the scene-changing IETMs). The statistics also show that all of the most commonly accessed content was on the topic of scene-changing[12].

Monthly Statistics for November 2010		
Total Hits		1644
Total Files		1292
Total Pages		176
Total Visits		80
Total Kbytes		1247459
Total Unique Sites		55
Total Unique URLs		187
Total Unique Referrers		12
Total Unique User Agents		27
	Avg	**Max**
Hits per Hour	2	248
Hits per Day	63	487
Files per Day	49	377
Pages per Day	6	33
Visits per Day	3	13
KBytes per Day	47979	785654

TABLE 2 THE USAGE STATISTICS FOR BLACKSTRYPE.COM DURING NOVEMBER 2010.

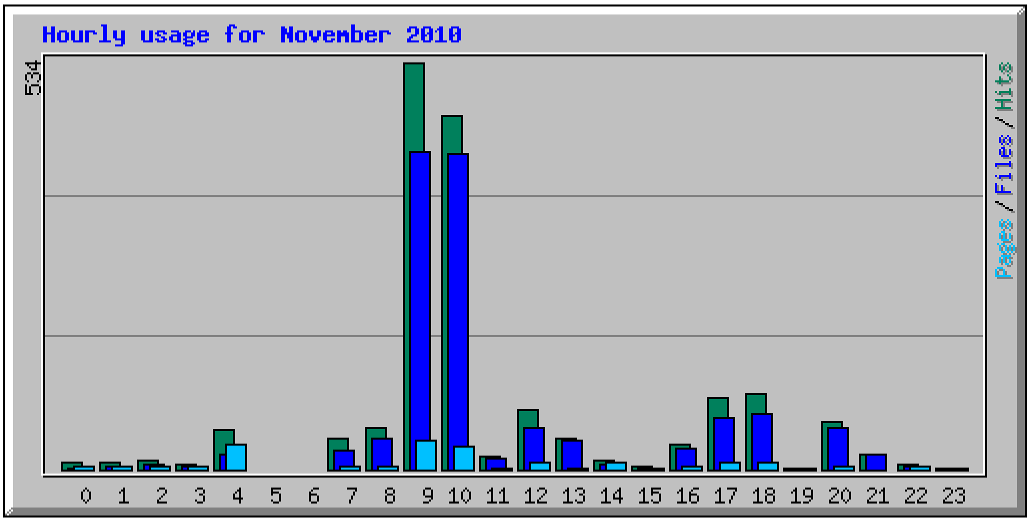

FIGURE 11 THE HOURLY USAGE FOR BLACKSTRYPE.COM. THE MAJORITY OF THE WEBSITE HITS TOOK PLACE DURING THE HOURS OF THE GE1030 CLASS (9:00 - 11:00)

[12] The most accessed IETM modules were alice_tips_and_tricks.xml (the IETM module automatically loaded on page-entry), alice_first_scene_change.xml, and how_to_make_a_scene.xml.

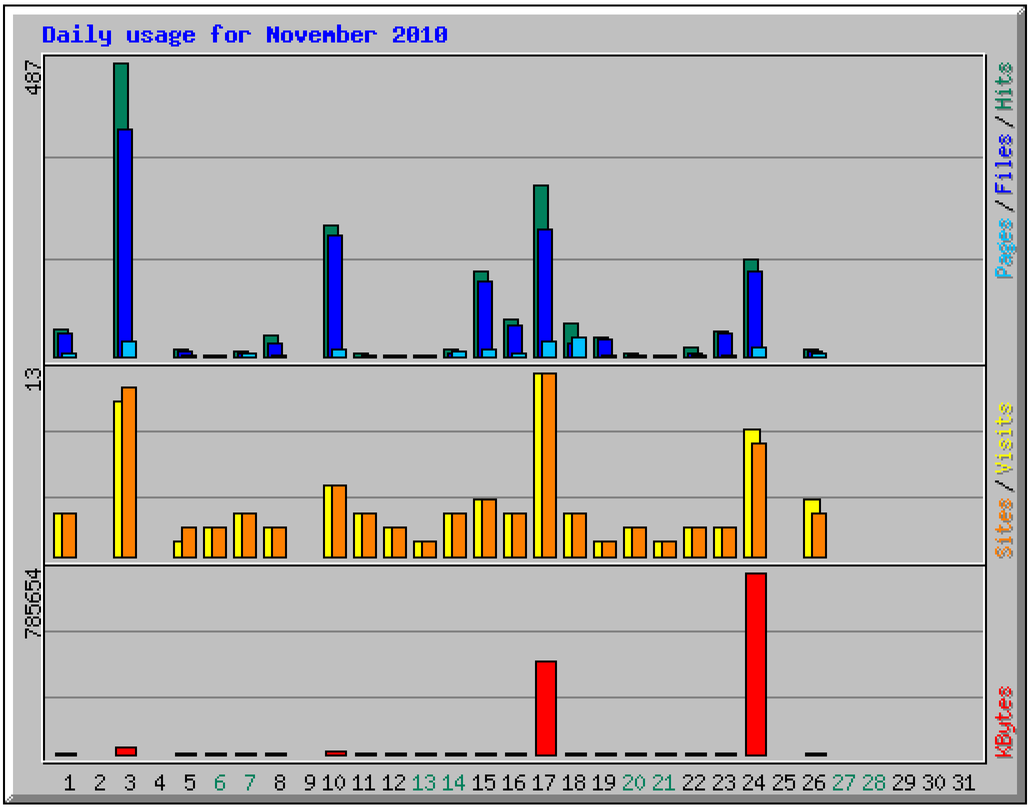

FIGURE 12 THE DAILY USAGE FOR BLACKSTRYPE.COM DURING THE MONTH OF NOVEMBER. THE HEAVIEST USAGE TOOK PLACE ON THE DAYS OF THE GE 1030 CLASS (3RD, 10TH, 17TH, AND 24TH). THE HEAVY KBYTES USAGE FOR SECTION 4 (17TH AND 24TH) IS DUE TO THE ADDITION OF DOWNLOADABLE VIDEO TUTORIALS WITHIN THE IETMS.

3.4 Summary of Results

The analyzed results show that there was no significant difference in ratings for understandability, nor usefulness between the experimental and control groups. The results also showed there was no significant difference in the amount of time students spent on specific topics between the two groups. However, students using PowerPoint slides declared spending significantly less time learning how to use Alice vehicles than did students using the IETM for reference materials. Overall, there was no significant difference in the total hours students spent completing the assignment between the experimental and control groups.

From class observation, the results showed that the experimental group spent significantly less time asking questions than the control group – meaning, the instructor spent less time addressing questions when students used the IETM as their reference materials.

The usage statistics showed that groups in Section 3 and Section 4 were using the IETMs regularly during class hours. Groups in Section 3 made more requests for the IETM materials, yet groups in Section 4 downloaded the large majority of the total content.

4 Conclusions

4.1 Review of the Results

The results analysis indicated that there were no significant differences in the effectiveness of the IETM when compared to the traditional PowerPoint tutorials for teaching introductory college students how to program in Alice. There are many possible reasons as to why the results did not show many measurable differences -- There were a number of noticeable complications during the research that could have caused these results. These complications are discussed in the following sub-sections. Also discussed is a review of the collected IETM usage statistics.

4.1.1 IETM User Interface Bug

One crucial fault to the study was a user interface bug in the IETM reference materials presented to Section 3. The correction of this problem was presented to the groups in Section 4 and it could have changed the final ratings of the IETM. In fact, groups in Section 4 spent, on average, 1.2 hours less than groups in Section 3, 0.9 hours less than groups in Section 2, and 1.9 hours less than groups in Section 1. Even with the buggy IETMs of Section 3, the IETM groups spent less time developing their projects than did the PowerPoint groups (statistical difference was at the 0.28 level).

Without the program bug in the IETM system, the spread in the results may have been larger and may have contributed to a more significant difference in results. In the future, the developed IETM tools need to be thoroughly tested before the comparison study is performed.

4.1.2 Differences in Class Instruction

Another potential fault is that each of the four sections was instructed slightly different. For example, Section 2 had about ten minutes of class instruction in scene changing, while Section 1 had none. As another example of varying instruction, Section 3 students were purposely directed to read through the IETM tutorials without guidance, while Section 4 students were provided with help in searching and finding information in the IETM tutorials. The results showed that groups in Section 2 and Section 4 spent less time on their assignments and rated the reference materials better than groups in Section 1 and Section 3. Furthermore, the observations notes suggest that groups from Section 1 and Section 3 may have been generally less satisfied with the reference materials they were given – they left comments on their surveys such as “Tutorials are somewhat confusing” and “Just a bit confusing and easy to make crucial mistakes”. In contrast, there were no comments from Sections 2 and 4 – signifying that they may have been generally more satisfied with the reference materials. It is possible that students responded to small instructional differences with a better or worse understanding of the topics, and they may have expressed this in the survey results. If the study were to be redone, a plan for more a consistent instructional approach would eliminate the differences seen in the survey results between adjacent sections.

4.1.3 Ambiguities in Survey

Though the survey went through multiple revisions, students seemed to have similar issues with correctly filling out the survey questions pertaining to time spent on Alice topics. This is most likely due to a combination of a few discrepancies in the presentation of question seven:

- The timeline of minute values presented was non-linear.
- The vertical hashes – meant to signify a selectable time – were too unusual and not comprehendible
- Often students did not respond to all parts of the question.
- The last three topics (concerning time for creating and using events, creating methods, and other Alice features) were not required for completing the assignment and should have been omitted from the survey

In some cases surveys were returned with responses circled in between the vertical hashes – making it difficult to assign a correctly represented value to the response. Also, on some surveys, the last three topics of question seven were left unanswered. Moreover, the responses to a large portion of the questions were not used in the final results analysis because they did not pertain to the hypothesis. If the study were to be redone, the survey would need to be updated with more relevant and more concise questions. It would also be useful to pilot test the survey before using it in the control study.

4.1.4 Insufficient Sample Sizes

The most crucial fault to the research was the small sample size. There were only seven surveys returned in Section 4 and there were only 36 surveys collected in total from all of the sections. The small sample sizes made it difficult to spot statistically significant differences between the IETM and the PowerPoint reference materials.

If the study were to be repeated, the number of participating groups would need to be increased. This would increase the degrees of freedom for measuring the differences between the experimental and control groups. It would also increase the degrees of freedom for measuring the differences between each section – making it easier to identify faults and uncontrolled variables occurring in the study.

4.1.5 Review of the IETM Usage Statistics

The usage statistics showed that the students in Sections 3 and 4 were regularly accessing the IETMs during class hours. This supports the idea that the students in the experimental group were actually using the IETM reference materials to complete their assignment.

The usage statistics also showed that students in Section 4 made a smaller percentage of the requests for IETM content than did Section 3. This could be largely because of the fix of the user interface bug discussed in section 4.1.1 , which may have made it more difficult to find targeted information. In other words, groups from Section 4 requested less IETM content, perhaps, because they were able to find the necessary information in less number of clicks.

Another interesting statistic is that the most frequently accessed content from the IETM reference materials was associated with scene-changing. Because scene-changing in Alice is known to be one of the more difficult concepts for the GE 1030 students it was expected that they would be searching frequently for information on scene-changing. Thus, the usage statistics support the notion that students in Sections 3 and 4 were able to easily access the IETM content that was pertinent to them.

The usage statistics also showed that students in Section 4 downloaded close to 95% of the total kilobytes sent from blackstrype.com. This is because the IETM reference materials were updated for the students in Section 4 to include instructional videos on scene-changing and using dummies. Because of the small samples sizes it was difficult to measure significant differences between Section 3 and Section 4. Therefore, it is questionable whether or not these videos contributed to differences in the IETM survey results. However, it is clear that the changes to the IETM dramatically skewed the kilobyte usage statistics. As discussed in section 4.1.4 , larger sample sizes would make it easier to identify the effect of these changes, but it would be equally important in future studies to avoid changing content in the middle of the study.

4.2 The Future of IETMs in the Classroom

Despite the measured results, there may still be a difference in the effectiveness of IETMs compared to traditional PowerPoint slides. Supporting this claim would require performing another control study with more students, and with more control over the instructional approach of each section. Also, the Alice PowerPoint tutorials have been in production for over three years now. Because the Alice IETM is still very new, more testing and development will need to be done in order to realize its full potential. A supplementary study could also be performed to measure the differences in effectiveness between the two generations of the Alice IETM.

It should also be noted that the instructor spent 42 minutes per class-period less answering questions for the Alice IETM sections compared to the PowerPoint sections. This is an important benefit of using IETM reference materials. Though the Alice IETM needs to be improved in other aspects, it has shown the potential to save instructors a significant amount of time – particularly if the class-size or the number of class sections increases.

Furthermore, although not statistically significant at the 0.05 level, the groups using the Alice IETM did spend 40 minutes less time finishing their assignments than the groups using PowerPoint slides. If the study were to be repeated with larger sample sizes, and a bug free Alice IETM, it could be supported more definitively that there is a significant difference in total time spent completing the assignment between the Alice IETM and PowerPoint slides.

Despite the current developmental flaws, the Alice IETM provides a different approach from the purely slide-based tutorial approach of the current PowerPoint tutorials and offers the students in the GE 1030 Software Engineering Module a more dynamic and less-cluttered access to the different Alice concepts. Thus, the results of this thesis should not be interpreted as entirely inconclusive on the overall effectiveness of IETMs. More time needs to be invested in improving the quality of the Alice IETM, and further research should be conducted to test its effectiveness against the PowerPoint materials being currently used.

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5.1 Other Mentioned Sources

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Lectora Inspire. http://www.trivantis.com/uk/lectora-inspire

SumTotal Toolbook. http://www.sumtotalsystems.com/products/toolbook-elearning-content.html

MyUdutu. http://www.myudutu.com/myudutu/login.aspx

Appendix A Class Survey

In the last 5 minutes of each class section, the GE 1030 SE Module Survey was given to each of the groups who worked on the Alice assignment. A copy of the survey is provided on the following pages.

GE 1030 SE Module Survey

The following survey will be used to measure the effectiveness of the reference materials and tutorials to improve how students learn to program in Alice. Please fill out the survey to the best of your knowledge. The information collected is anonymous and it will not affect your grade. Filling out this survey is optional.

1. Which GE 1030 section are you in?	1	2	3	4

2. Has anyone in your group ever worked with Alice before this course (GE 1030)?	Yes	No

3. Has anyone in your group ever worked with written programs in languages such as Java, Visual Basic, or HTML?	Yes	No

4. On average, about how long would you say it took your group (**in minutes**) to find (not including time spent reading) specific content or tutorials that you needed for creating your program in Alice? (Circle a vertical hash)
`0 1 2 3 4 5 6 7 8 9 10 More` `|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-->`

5. Which of the following best describes the ***understandability*** of the examples provided in the Alice reference materials and tutorials?	
	Confusing – Examples were too confusing or difficult to follow
	Slightly Confusing – It took a few tries through to fully understand most of the examples
	Comprehensible – Examples were understandable enough, but it was still somewhat hard to follow
	Understandable – Only a few examples that seemed confusing; Most were understandable
	Easily Understandable – All examples were very clear and easy to understand.

6. Which of the following best describes the *usefulness* of the examples provided in the Alice reference materials and tutorials?	
	Not useful at all – Never followed the examples
	Barely useful – Rarely followed the examples
	Sometimes useful – Found useful tips and information in some of the examples
	Useful – Followed the examples frequently, but had to look elsewhere for extra information
	Very Useful – The post-lecture materials had great examples for all aspects of Alice programming

<table>
<tr><td colspan="2">7. How long do you estimate your group spent (in minutes) learning the following Alice subjects in order to satisfy the basic requirements of this course? (Circle a vertical hash)</td></tr>
<tr><td></td><td>0 1 5 10 20 30 more</td></tr>
<tr><td>Scene Changing</td><td>|--|--|--|--|--|--|--|--|--|--|--></td></tr>
<tr><td>Adding Objects</td><td>|--|--|--|--|--|--|--|--|--|--|--></td></tr>
<tr><td>Positioning Objects (Characters)</td><td>|--|--|--|--|--|--|--|--|--|--|--></td></tr>
<tr><td>Using Vehicles</td><td>|--|--|--|--|--|--|--|--|--|--|--></td></tr>
<tr><td>Moving Characters</td><td>|--|--|--|--|--|--|--|--|--|--|--></td></tr>
<tr><td>Moving Body parts of Characters</td><td>|--|--|--|--|--|--|--|--|--|--|--></td></tr>
<tr><td>Moving the Camera</td><td>|--|--|--|--|--|--|--|--|--|--|--></td></tr>
<tr><td>Creating and Using Events</td><td>|--|--|--|--|--|--|--|--|--|--|--></td></tr>
<tr><td>Creating and Using Your Own Methods</td><td>|--|--|--|--|--|--|--|--|--|--|--></td></tr>
<tr><td>Other Alice Features (Describe)</td><td>|--|--|--|--|--|--|--|--|--|--|--></td></tr>
</table>

8. Did your group receive any help outside of class from other GE 1030 students on any of the subjects listed above? If yes, which subjects?

<table>
<tr><td>9. How long would you say it took your group (in hours) to completely satisfy the requirements of the Alice program for the GE 1030 SE Module?</td></tr>
<tr><td>0 1 2 3 4 5 6 7 8 9 10 More
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--></td></tr>
</table>

Please give any comments or suggestions for improvement below or on the back of this sheet.

Thanks for taking the survey!
Please ask your instructor if you have any questions or concerns.

Appendix B Observational Data

B.1. In-class Questions Asked

B.2. Comments and other Noted Observations

B.2.1. Section 1:

The first 15 minutes of Section 1 were spent demonstrating how to open Alice, how to add objects, and do other basic commands (move, move parts). The students were then allowed to test out Alice freely.

After another 15 minutes students were given another demonstration of the Do Together feature of Alice, Vehicles, and How to add different terrain.

The first day of Alice instruction was a bit awkward because the instructor had not taught the material in a while.

The second day of instruction a student commented that the vehicles tutorials provided from the GE 103 website were "too complicated"

B.2.2. Section 2:

Much like Section 1, the first day consisted of 15 minute demonstrations – spread over 2 hours – of the different Alice features.

The demonstrations appeared to be more fluid and informative (in comparison to Section 1). Unlike Section 1, a demonstration of scene-changing was presented halfway through the two hour period.

One student had to request additional help on scene-changing after looking at the reference materials provided from the GE 1030 website. The provided scene-changing tutorials were notably difficult to follow with an abundance of excess information (scene changing effects, camera lens angle, etc.).

B.2.3. Section 3:

The beginning of Section 3 was devoted to demonstrating the basics of Alice – similar to Sections 1 and 2. The topics covered were moving the camera, moving sub-parts, Do Together, Do in Order, Undo , Redo, Vehicles, Properties, Disabling commands, dropping dummies at the camera, using Set Point of View.

It was quickly observed that students were confused with the starting point of using the Alice IETM. There was a large amount of unfruitful clicking as students attempted to open up the collapsed modules and linking.

An unjustifiable amount of time was spent explaining how to navigate the tool, all of which resulted in more frustration and less time spent addressing questions pertaining to Alice.

During the second day of the course (the last two hours), students abandoned the IETM tutorials and simply asked for the instructor's help.

B.2.4. Section 4:

Section 4 was given demonstrations of adding objects, moving the camera in the editor, positioning objects, affecting sub-parts, move command, Do Together block, Do in Order block, deleting objects, vehicles, and setting up a new scene.

Group 8 still had trouble finding answers to their questions with the Alice IETM.

The IETM was not presented as an option for the students for the first hour of the class.

Students who asked about scene-changing were pointed directly to the IETM tutorials.

One student who was absent on the first day managed to get started on his own without asking any questions and only very briefly looking at the tutorials.

B.3. Structure of Data-collection Worksheets

For each section the Observation Worksheet was used to collect organized data of how groups used the reference materials, what questions were asked, and how long it took respond to the questions. A copy the observation worksheet is provided

IETM Observation Worksheet
Section:
Instructor: Dr. Hasker
Lab Assistant:
Date:

Time Spent by Instructor addressing the entire class:

(Record questions asked to instructor or assistant – for each, provide the group number and how long it took to address the question)

Group	Time	Question
____	____	____
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Comments:

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30 Minute Individual Group Observation
Group Number:

(Observe amount of time spent with post-lecture reference materials)

Time Spent Topic

__________ ____
__________ ____
__________ ____
__________ ____
__________ ____

Observed Difficulties:

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Comments:

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Appendix C Open Office Graphs

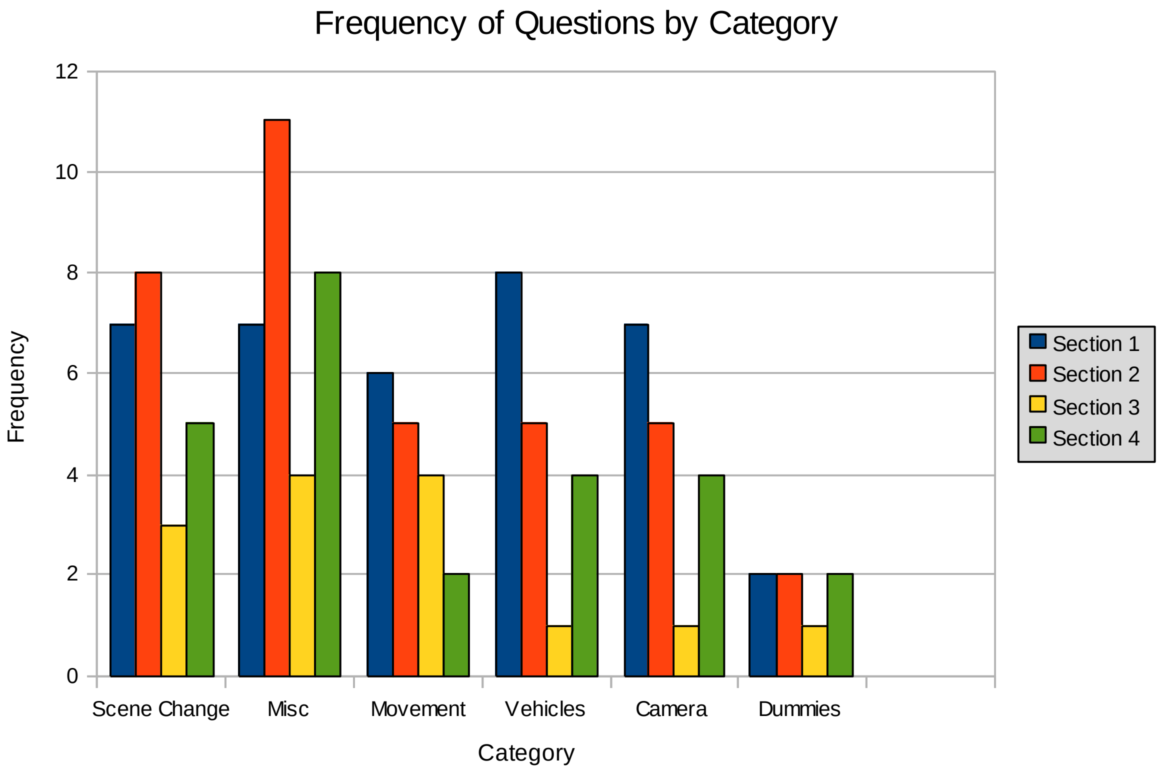

Figure 13: The data shows the higher frequency of questions asked in the first two (non-IETM) sections. Section 3 had the least questions asked. Note: they also provided the lowest ratings for the tool.

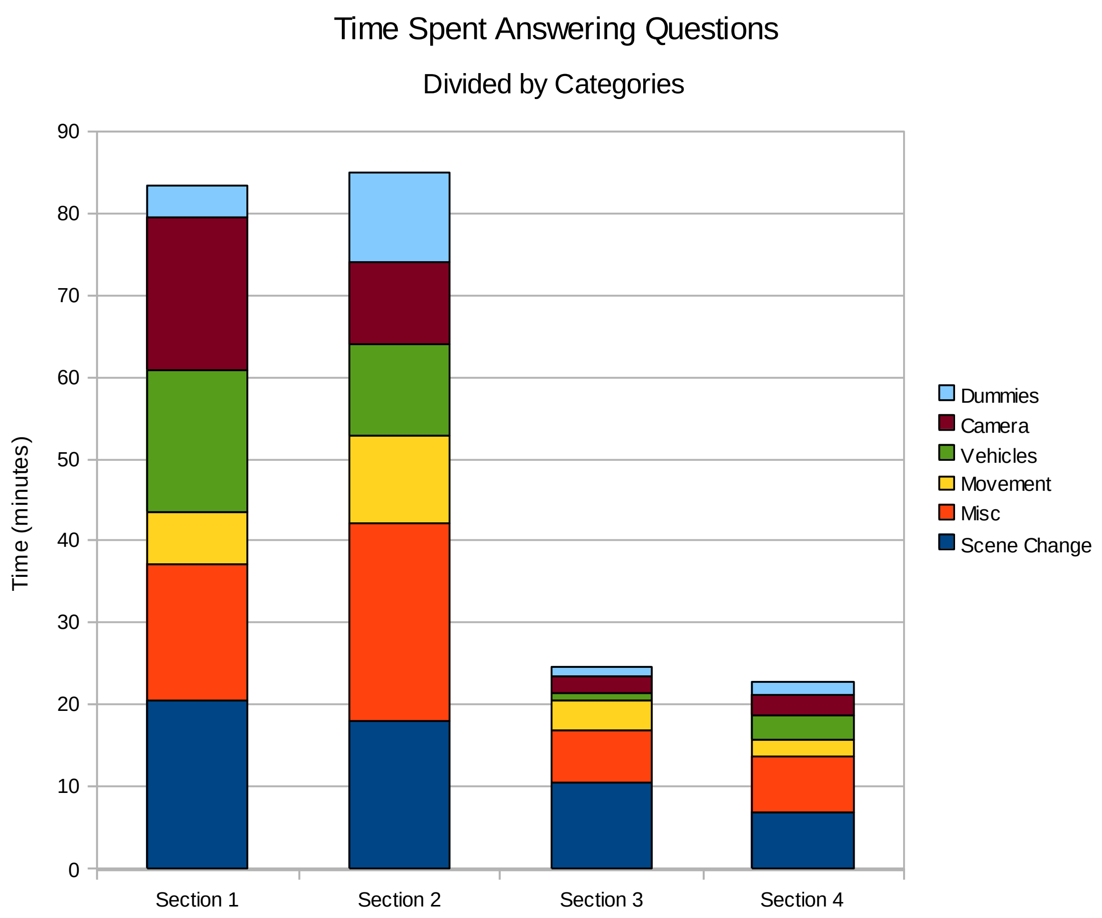

Figure 14: The data shows that despite the frequency of questions, less time was spent in Sections 3 and 4 to resolve questions.

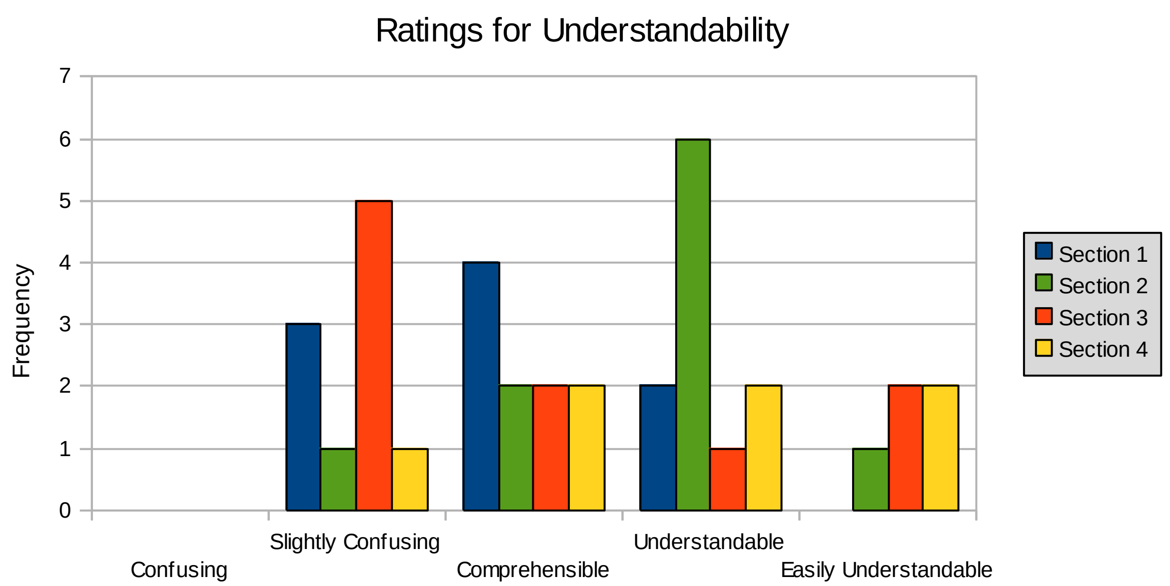

Figure 15: The graph shows frequency of ratings for understandability for each section. Section 2 has the strongest distribution for being consistently understandable. The lack of surveys filled out in Section 4 can be seen in the weakly-visible distribution.

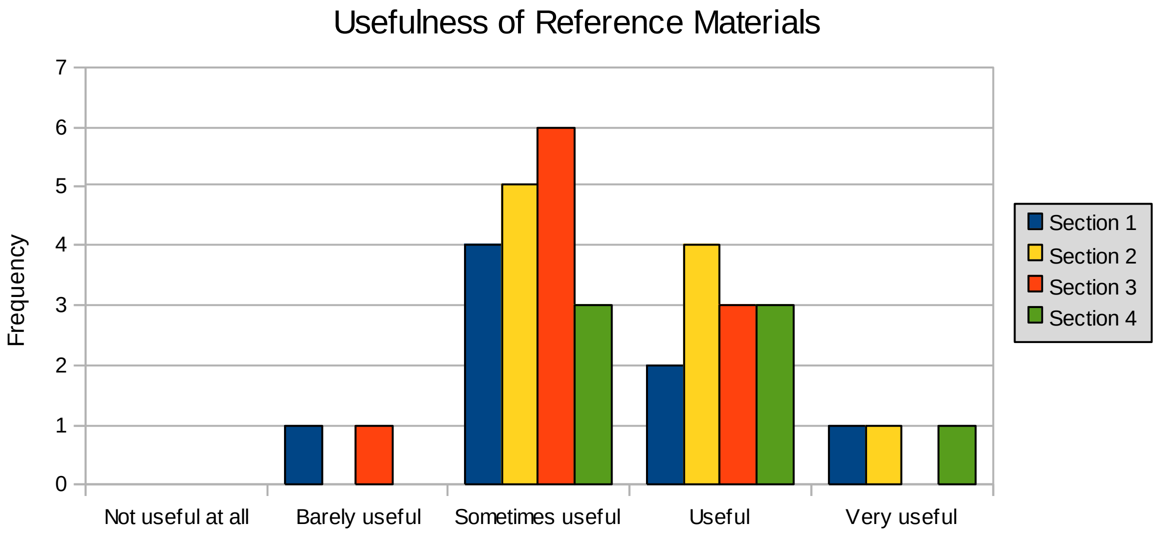

Figure 16: The graph shows the ratings for the usefulness of the reference materials. Section 4, though weak in numbers, has a higher average distribution of rated usefulness.

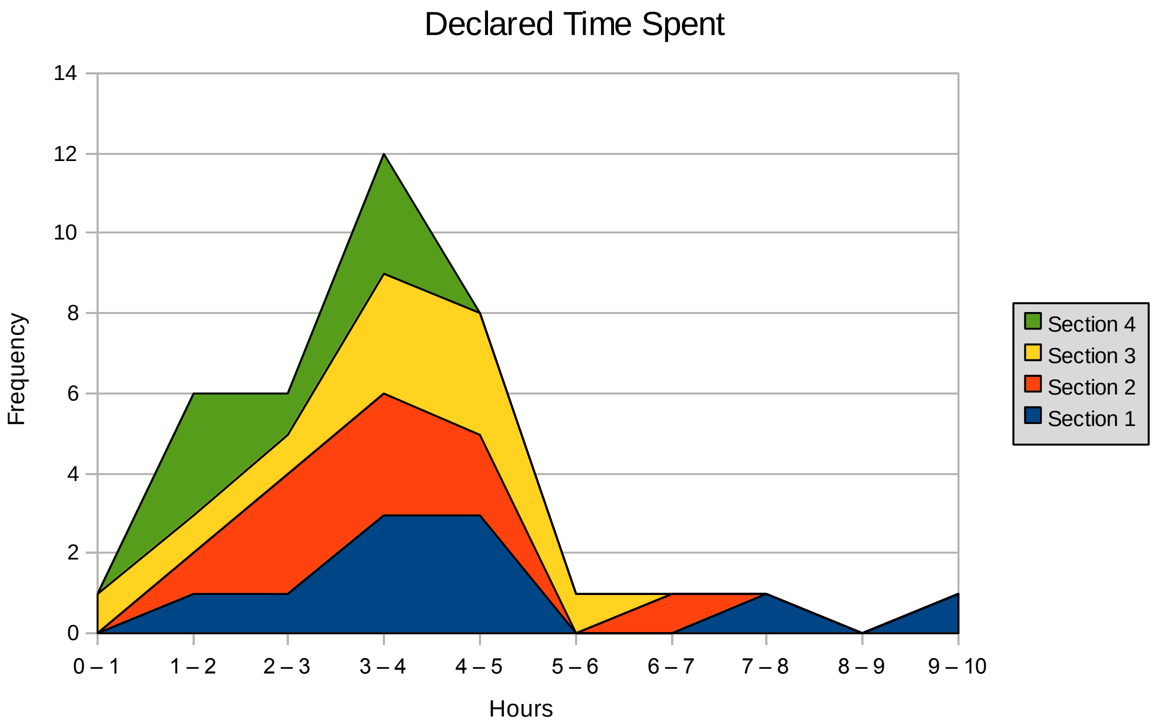

Figure 17: The graph shows the students in all sections generally took a bit less than 4 hours (allotted class time) in order to satisfy the requirements of the GE 1030 Alice assignment. Students in sections 1 and 2 had a few groups who claimed to have spent more than 4 hours on their assignments.

Appendix D November Usage Statistics Collected from blackstrype.com

The usage statistics from blackstrype.com – the hosting site for the IETMs – can be found below. They were collected from InMotion Hosting's Webalizer built-in usage engine. A quick explanation of the Webalizer terminology can be found here: http://www.mrunix.net/webalizer/webalizer_help.html

Monthly Statistics for November 2010		
Total Hits		**1644**
Total Files		**1292**
Total Pages		**176**
Total Visits		**80**
Total KBytes		**1247459**
Total Unique Sites		**55**
Total Unique URLs		**187**
Total Unique Referrers		**12**
Total Unique User Agents		**27**
	Avg	**Max**
Hits per Hour	**2**	**248**
Hits per Day	**63**	**487**
Files per Day	**49**	**377**
Pages per Day	**6**	**33**
Visits per Day	**3**	**13**
KBytes per Day	**47979**	**785654**
Hits by Response Code		
Code 200 - OK		**1292**
Code 206 - Partial Content		**1**
Code 301 - Moved Permanently		**53**
Code 304 - Not Modified		**128**
Code 404 - Not Found		**170**

TABLE 3 SUMMARY OF NOVEMBER USAGE STATISTICS FOR BLACKSTRYPE.COM

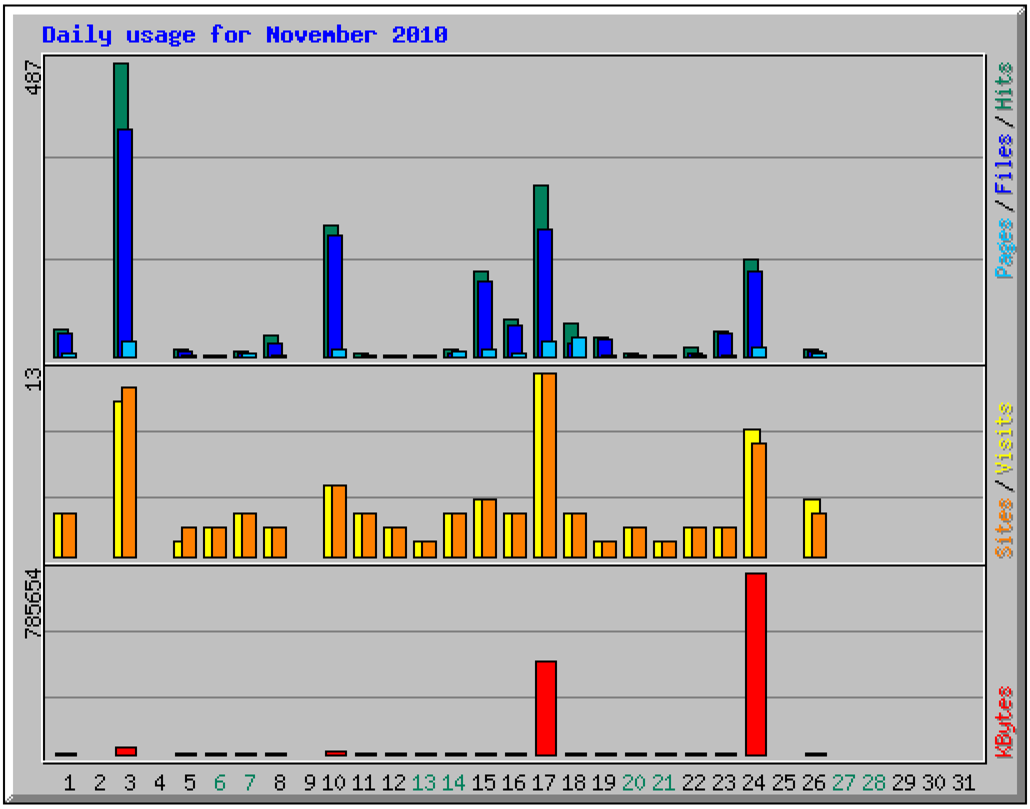

FIGURE 18 THE DAILY USAGE FOR BLACKSTRYPE.COM DURING THE MONTH OF NOVEMBER.

Daily Statistics for November 2010												
Day	Hits		Files		Pages		Visits		Sites		KBytes	
1	46	2.80%	38	2.94%	5	2.84%	3	3.75%	3	5.45%	1720	0.14%
2	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
3	487	29.62%	377	29.18%	26	14.77%	11	13.75%	12	21.82%	29736	2.38%
4	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
5	12	0.73%	9	0.70%	2	1.14%	1	1.25%	2	3.64%	204	0.02%
6	3	0.18%	2	0.15%	2	1.14%	2	2.50%	2	3.64%	7	0.00%
7	9	0.55%	5	0.39%	4	2.27%	3	3.75%	3	5.45%	24	0.00%
8	36	2.19%	22	1.70%	2	1.14%	2	2.50%	2	3.64%	2095	0.17%
9	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
10	217	13.20%	202	15.63%	11	6.25%	5	6.25%	5	9.09%	15590	1.25%
11	5	0.30%	0	0.00%	3	1.70%	3	3.75%	3	5.45%	0	0.00%
12	3	0.18%	2	0.15%	2	1.14%	2	2.50%	2	3.64%	7	0.00%
13	1	0.06%	1	0.08%	1	0.57%	1	1.25%	1	1.82%	3	0.00%
14	13	0.79%	6	0.46%	8	4.55%	3	3.75%	3	5.45%	26	0.00%
15	142	8.64%	123	9.52%	13	7.39%	4	5.00%	4	7.27%	7553	0.61%
16	62	3.77%	53	4.10%	6	3.41%	3	3.75%	3	5.45%	2684	0.22%
17	282	17.15%	210	16.25%	25	14.20%	13	16.25%	13	23.64%	398066	31.91%
18	55	3.35%	22	1.70%	33	18.75%	3	3.75%	3	5.45%	453	0.04%
19	33	2.01%	27	2.09%	2	1.14%	1	1.25%	1	1.82%	1621	0.13%
20	4	0.24%	2	0.15%	3	1.70%	2	2.50%	2	3.64%	7	0.00%

21	1	0.06%	1	0.08%	1	0.57%	1	1.25%	1	1.82%	3	0.00%
22	15	0.91%	4	0.31%	3	1.70%	2	2.50%	2	3.64%	16	0.00%
23	43	2.62%	37	2.86%	3	1.70%	2	2.50%	2	3.64%	1960	0.16%
24	162	9.85%	142	10.99%	15	8.52%	9	11.25%	8	14.55%	785654	62.98%
25	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
26	13	0.79%	7	0.54%	6	3.41%	4	5.00%	3	5.45%	31	0.00%

TABLE 4 THE DAILY USAGE STATISTICS FOR NOVEMBER. THE GE 1030 CLASSES TOOK PLACE ON THE 3RD, THE 10TH, THE 17TH, AND THE 24TH.

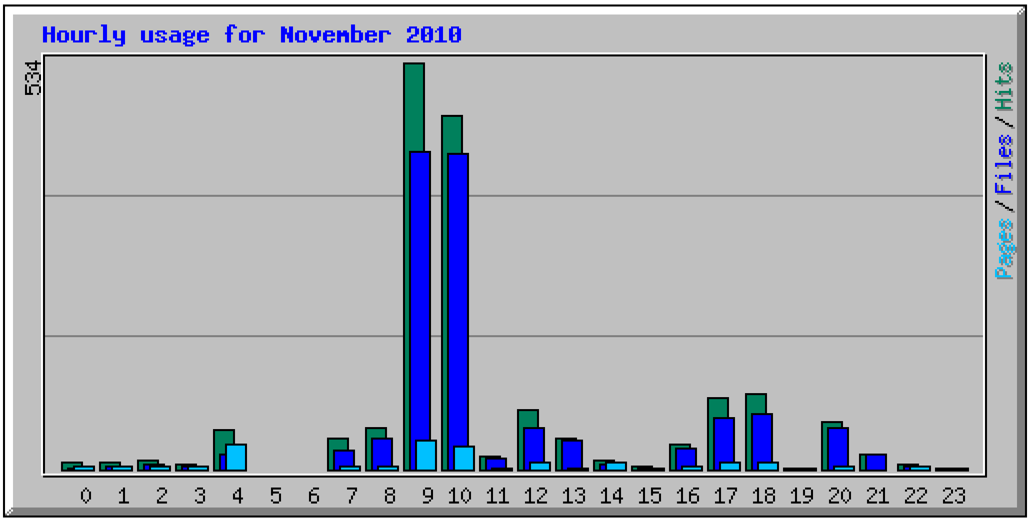

FIGURE 19 THE HOURLY USAGE FOR BLACKSTRYPE.COM SHOWS THAT STUDENTS WERE USING THE IETMS PRIMARILY DURING CLASS HOURS (09:00 TO 11:00).

Hourly Statistics for November 2010												
Hour	Hits			Files			Pages			KBytes		
	Avg	Total		Avg	Total		Avg	Total		Avg	Total	
0	0	8	0.49%	0	2	0.15%	0	3	1.70%	0	8	0.00%
1	0	8	0.49%	0	4	0.31%	0	4	2.27%	1	16	0.00%
2	0	11	0.67%	0	6	0.46%	0	5	2.84%	1	32	0.00%
3	0	6	0.36%	0	3	0.23%	0	4	2.27%	0	11	0.00%
4	2	52	3.16%	0	20	1.55%	1	32	18.18%	17	445	0.04%
5	0	0	0.00%	0	0	0.00%	0	0	0.00%	0	0	0.00%
6	0	0	0.00%	0	0	0.00%	0	0	0.00%	0	0	0.00%
7	1	40	2.43%	0	25	1.93%	0	3	1.70%	34	886	0.07%
8	2	55	3.35%	1	42	3.25%	0	5	2.84%	53	1384	0.11%
9	20	534	32.48%	16	417	32.28%	1	38	21.59%	45824	1191414	95.51%
10	17	463	28.16%	15	413	31.97%	1	29	16.48%	1247	32413	2.60%
11	0	18	1.09%	0	15	1.16%	0	2	1.14%	8	197	0.02%
12	3	78	4.74%	2	53	4.10%	0	8	4.55%	107	2786	0.22%
13	1	41	2.49%	1	37	2.86%	0	2	1.14%	75	1960	0.16%
14	0	11	0.67%	0	6	0.46%	0	8	4.55%	1	21	0.00%
15	0	3	0.18%	0	2	0.15%	0	2	1.14%	0	8	0.00%
16	1	33	2.01%	1	27	2.09%	0	3	1.70%	62	1620	0.13%

17	3	93	5.66%	2	67	5.19%	0	9	5.11%	201	5224	0.42%
18	3	99	6.02%	2	73	5.65%	0	9	5.11%	184	4772	0.38%
19	0	1	0.06%	0	1	0.08%	0	1	0.57%	0	3	0.00%
20	2	61	3.71%	2	54	4.18%	0	5	2.84%	112	2909	0.23%
21	0	21	1.28%	0	21	1.63%	0	0	0.00%	51	1334	0.11%
22	0	6	0.36%	0	4	0.31%	0	3	1.70%	1	15	0.00%
23	0	2	0.12%	0	0	0.00%	0	1	0.57%	0	0	0.00%

TABLE 5 THE HOURLY USAGE STATISTICS FOR BLACKSTRYPE.COM DURING NOVEMBER.

Top 30 of 187 Total URLs

#	Hits		KBytes		URL
1	71	4.32%	169	0.01%	/tivit/
2	59	3.59%	350	0.03%	/tivit/proto_style_light.css
3	55	3.35%	90	0.01%	/tivit/ietms/ietm_files.xml
4	55	3.35%	683	0.05%	/tivit/js/protoCall.js
5	52	3.16%	419	0.03%	/tivit/ProtoXSLT.xsl
6	47	2.86%	7	0.00%	/tivit/collapsedTitleArrow.png
7	38	2.31%	6	0.00%	/tivit/expandedTitleArrow.png
8	34	2.07%	77	0.01%	/tivit/ietms/alice_tips_and_tricks.xml
9	32	1.95%	10	0.00%	/tivit/ietms/ietm_files.xsl
10	32	1.95%	3680	0.30%	/tivit/lib/jquery/jquery-1.4.2.js
11	28	1.70%	195	0.02%	/tivit/ietms/alice_first_scene_change.xml
12	26	1.58%	76	0.01%	/
13	26	1.58%	491	0.04%	/tivit/img/alice_scene_set_point_of_view.png
14	26	1.58%	528	0.04%	/tivit/img/alice_scene_set_point_of_view_next.png
15	26	1.58%	5221	0.42%	/tivit/img/scene_10.png
16	26	1.58%	3129	0.25%	/tivit/img/scene_4.png
17	26	1.58%	5142	0.41%	/tivit/img/scene_9.png
18	23	1.40%	1410	0.11%	/tivit/lib/jquery/jquery-1.4.2.min.js

19	**18**	1.09%	**33**	0.00%	/tivit/ietms/how_to_make_a_scene.xml
20	**14**	0.85%	**706**	0.06%	/tivit/img/alice_basic_next_scene.png
21	**14**	0.85%	**2058**	0.16%	/tivit/img/alice_next_scene_finish.png
22	**14**	0.85%	**1149**	0.09%	/tivit/img/alice_scene_1_method.png
23	**14**	0.85%	**275**	0.02%	/tivit/img/alice_set_duration.png
24	**14**	0.85%	**3153**	0.25%	/tivit/img/scene_11.png
25	**14**	0.85%	**196**	0.02%	/tivit/img/scene_15.png
26	**14**	0.85%	**1314**	0.11%	/tivit/img/scene_16.png
27	**14**	0.85%	**595**	0.05%	/tivit/img/scene_17.png
28	**14**	0.85%	**1308**	0.10%	/tivit/img/scene_18.png
29	**14**	0.85%	**4074**	0.33%	/tivit/img/scene_19.png
30	**14**	0.85%	**1866**	0.15%	/tivit/img/scene_3.png

TABLE 6 THE 30 MOST ACCESSED URLS FOR BLACKSTRYPE.COM DURING NOVEMBER. EXCLUDING THE ALICE IETM BASE FILES, ALL OF THE URLS ARE STRICTLY RELATED TO SCENE-CHANGING.

Top 10 of 187 Total URLs By KBytes

#	Hits		KBytes		URL
1	**2**	0.12%	**771257**	61.83%	/tivit/vid/firstSceneChangeDemo.avi
2	**1**	0.06%	**391850**	31.41%	/tivit/vid/dummies_video.avi
3	**26**	1.58%	**5221**	0.42%	/tivit/img/scene_10.png
4	**26**	1.58%	**5142**	0.41%	/tivit/img/scene_9.png
5	**10**	0.61%	**4917**	0.39%	/tivit/img/alice_set_point_of_view_step_5.png
6	**2**	0.12%	**4165**	0.33%	/tivit/other/sceneChanging.a2w
7	**14**	0.85%	**4074**	0.33%	/tivit/img/scene_19.png
8	**32**	1.95%	**3680**	0.30%	/tivit/lib/jquery/jquery-1.4.2.js

9	2	0.12%	3320	0.27%	/tivit/img/derossisniper.gif
10	14	0.85%	3153	0.25%	/tivit/img/scene_11.png

TABLE 7 THE TOP 10 URLS IN TERMS OF KBYTES DOWNLOADED. THE TWO VIDEO FILES FOR SCENE-CHANGING AND USING DUMMIES MAKE FOR MORE THAT 93% OF THE DOWNLOADED CONTENT.

Top 2 of 2 Total Entry Pages					
#	Hits		Visits		URL
1	26	1.58%	25	75.76%	/
2	71	4.32%	8	24.24%	/tivit/

TABLE 8 THE PAGE ENTRY STATISTICS SHOW THAT 3 OUT OF 4 VISITERS ACCESSED BLACKSTRYPE.COM BY THE BASE URL (BLACKSTRYPE.COM/). THE OTHER 25% OF VISITERS ENTERED DIRECTLY TO BLACKSTRYPE.COM/TIVIT/.

Top 3 of 3 Total Exit Pages					
#	Hits		Visits		URL
1	71	4.32%	55	73.33%	/tivit/
2	26	1.58%	19	25.33%	/
3	10	0.61%	1	1.33%	/tivit/lib/jquery/

TABLE 9 PAGE EXIT STATISTICS. 73.33% OF ALL VISITS LEFT FROM THE ALICE IETM WEBPAGE.

Top 30 of 55 Total Sites									
#	Hits		Files		KBytes		Visits		Hostname
1	180	10.95%	158	12.23%	12393	0.99%	4	5.00%	137.104.120.190
2	157	9.55%	143	11.07%	10315	0.83%	5	6.25%	137.104.120.210
3	144	8.76%	97	7.51%	6191	0.50%	6	7.50%	h184-60-15-13.vrnawi.dsl.dynamic.tds.net
4	130	7.91%	75	5.80%	5977	0.48%	1	1.25%	137.104.121.106
5	110	6.69%	91	7.04%	399896	32.06%	3	3.75%	137.104.120.244
6	99	6.02%	93	7.20%	6800	0.55%	2	2.50%	137.104.120.195
7	99	6.02%	92	7.12%	7754	0.62%	2	2.50%	137.104.121.238
8	80	4.87%	71	5.50%	4708	0.38%	2	2.50%	137.104.120.240
9	74	4.50%	71	5.50%	4226	0.34%	1	1.25%	137.104.120.136
10	70	4.26%	65	5.03%	4752	0.38%	1	1.25%	137.104.120.248
11	56	3.41%	49	3.79%	1629	0.13%	2	2.50%	hasker.cs.uwplatt.edu

12	50	3.04%	19	1.47%	442	0.04%	1	1.25%	205.251.121.5
13	46	2.80%	24	1.86%	387233	31.04%	3	3.75%	137.104.120.172
14	42	2.55%	39	3.02%	2289	0.18%	1	1.25%	137.104.121.127
15	39	2.37%	26	2.01%	2107	0.17%	1	1.25%	137.104.178.207
16	38	2.31%	21	1.63%	1059	0.08%	2	2.50%	137.104.110.234
17	25	1.52%	22	1.70%	387167	31.04%	1	1.25%	137.104.121.1
18	20	1.22%	14	1.08%	306	0.02%	2	2.50%	137.104.121.12
19	17	1.03%	15	1.16%	705	0.06%	1	1.25%	137.104.120.239
20	16	0.97%	13	1.01%	211	0.02%	1	1.25%	98-125-97-116.dyn.centurytel.net
21	12	0.73%	9	0.70%	116	0.01%	1	1.25%	137.104.114.23
22	12	0.73%	9	0.70%	116	0.01%	1	1.25%	137.104.120.89
23	12	0.73%	9	0.70%	205	0.02%	1	1.25%	137.104.121.99
24	11	0.67%	9	0.70%	204	0.02%	1	1.25%	137.104.121.208
25	11	0.67%	9	0.70%	116	0.01%	1	1.25%	190.241.62.125
26	11	0.67%	6	0.46%	32	0.00%	3	3.75%	b3090911.crawl.yahoo.net
27	8	0.49%	5	0.39%	190	0.02%	1	1.25%	137.104.121.132
28	8	0.49%	5	0.39%	190	0.02%	1	1.25%	137.104.121.142
29	7	0.43%	4	0.31%	19	0.00%	2	2.50%	b3090770.crawl.yahoo.net
30	7	0.43%	3	0.23%	12	0.00%	2	2.50%	crawl-66-249-65-174.googlebot.com

TABLE 10 THE TOP 30 VISITERS TO THE SITE ORIGINATED FROM A UW-PLATTEVILLE IP.

Top 10 of 55 Total Sites By KBytes

#	Hits		Files		KBytes		Visits		Hostname
1	110	6.69%	91	7.04%	399896	32.06%	3	3.75%	137.104.120.244
2	46	2.80%	24	1.86%	387233	31.04%	3	3.75%	137.104.120.172
3	25	1.52%	22	1.70%	387167	31.04%	1	1.25%	137.104.121.1
4	180	10.95%	158	12.23%	12393	0.99%	4	5.00%	137.104.120.190
5	157	9.55%	143	11.07%	10315	0.83%	5	6.25%	137.104.120.210
6	99	6.02%	92	7.12%	7754	0.62%	2	2.50%	137.104.121.238
7	99	6.02%	93	7.20%	6800	0.55%	2	2.50%	137.104.120.195
8	144	8.76%	97	7.51%	6191	0.50%	6	7.50%	h184-60-15-13.vrnawi.dsl.dynamic.tds.net
9	130	7.91%	75	5.80%	5977	0.48%	1	1.25%	137.104.121.106
10	70	4.26%	65	5.03%	4752	0.38%	1	1.25%	137.104.120.248

TABLE 11 THE MAJORITY OF THE KBYTES DOWNLOADED FROM BLACKSTRYPE.COM WERE SENT TO UW-PLATTEVILLE IPS.

Top 12 of 12 Total Referrers			
#	Hits		Referrer
1	1100	66.91%	http://www.blackstrype.com/tivit/
2	246	14.96%	- (Direct Request)
3	150	9.12%	http://blackstrype.com/tivit/
4	56	3.41%	http://www.uwplatt.edu/csse/Courses/ge103/
5	51	3.10%	http://www.blackstrype.com/tivit/proto_style_light.css
6	20	1.22%	http://www.uwplatt.edu/csse/courses/ge103/
7	8	0.49%	http://blackstrype.com/
8	4	0.24%	http://blackstrype.com/tivit/proto_style_light.css
9	3	0.18%	http://whois.domaintools.com/blackstrype.com
10	3	0.18%	http://www.blackstrype.com/
11	1	0.06%	http://www.sitetalk-info.de
12	1	0.06%	http://www.way-to-success.com

TABLE 12 MOST REFERRERS TO BLACKSTRYPE.COM WERE DIRECT REQUESTS. A SMALL NUMBER WERE ALSO FROM THE GE 1030 WEBSITE LINK.

Top 15 of 27 Total User Agents			
#	Hits		User Agent
1	807	49.09%	Mozilla/5.0 (Windows; U; Windows NT 5.1; en-US; rv:1.9.2.8) G
2	233	14.17%	Mozilla/5.0 (Windows; U; Windows NT 6.1; en-US) AppleWebKit/5
3	158	9.61%	Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.
4	133	8.09%	Mozilla/5.0 (Windows; U; Windows NT 5.1; en-US; rv:1.9.2.10)
5	68	4.14%	Mozilla/5.0 (Windows; U; Windows NT 5.1; en-US; rv:1.9.2.12)
6	50	3.04%	panscient.com
7	44	2.68%	Mozilla/5.0 (Windows; U; Windows NT 5.1; en-US) AppleWebKit/5
8	39	2.37%	Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10.6; en-US; rv:1.9
9	28	1.70%	Mozilla/5.0 (Windows; U; Windows NT 5.1; en-US; rv:1.9.2.11)
10	17	1.03%	Mozilla/5.0 (compatible; Yahoo! Slurp; http://help.yahoo.com/
11	13	0.79%	Mozilla/5.0 (compatible; Googlebot/2.1; +http://www.google.co
12	12	0.73%	Mozilla/5.0 (Windows; U; Windows NT 5.1; en-US; rv:1.9.2) Gec

13	**7**	0.43%	Mozilla/5.0 (compatible; Yahoo! Slurp/3.0; http://help.yahoo.
14	**6**	0.36%	Mozilla/5.0 (compatible; bingbot/2.0; +http://www.bing.com/bi
15	**5**	0.30%	Mozilla/5.0 (X11; U; Linux i686; en-US; rv:1.9.1.3; ips-agent

TABLE 13 USER AGENTS, OR WEB BROWSERS USED TO ACCESS BLACKSTRYPE.COM DURING NOVEMBER 2010.

Appendix E Tagset Specification

The following is provided as an overview of the tags that are used to author an IETM. The tagset has not been formalized. It is simply meant to be a prototype of what future IETM authors have to work with.

<var>

Description: Setup to be inserted into the JavaScript logic block as a standard global variable[13]. It is meant to be managed and used by other IETM logic. This tag has not been fully developed and tested.

Attributes:

id – the unique identifier for the variable.

value – the value that the variable is initialized to.

Usage:

```
<var id="birthYear" value="1985"/>
```

<expression>

Description: Setup to be inserted into the JavaScript block as a static expression. Unlike a variable the expression is static, but the evaluation of the expression, which can be triggered by other IETM logic provides a dynamic value.

Usage:

```
<expression id="age" value="currentYear - birthYear"/>
```

<cblock>

Description: A basic HTML content block intended to wrap any sort of document content.

Child Elements: any

Usage:

```
<cblock>
  <para>Here is a content block.</para>
  <image>
    ...
  </image>
  ...
</cblock>
```

<stepset>

Description: The containing block for a series of steps and branches that make up a step-by-step procedure. The original intent is that the stepset is treated as a miniature slide-show within the IETM document.

Child Elements: <step>, <branch>

Usage:

[13] 'global' is not desired, but stands as the current implementation.

```
<stepset>
  <step>
    <para>Step 1. Create the stepset opening and closing tags</para>
  </step>
  <step>
    <para>Step 2. Fill the stepset with steps.</para>
  </step>
  <branch>
    <para>Choose if you want to complete the stepset with branches or not.</para>
    <path="With Branches">
      <step>
        <para>Add paths to your branch</para>
      </step>
    </path>
    <path="Without Branches">
      <step>
        <para>A path can be empty as well...just remove this step.</para>
      </step>
    </path>
  </branch>
  <step>
    <para>Step 3. You can add branches within paths.</para>
  </step>
</stepset>
```

<branch>

Description: The containing block for a branch in a step-by-step procedure. A branch contains multiple different <path>s towards completing a procedure. Branches are used when there is a choice in how to complete a <stepset>.

Child Elements: <path>

Usage:

```
<stepset>
  <step>
    <para>Step 1. Create the stepset opening and closing tags</para>
  </step>
  <step>
    <para>Step 2. Fill the stepset with steps.</para>
  </step>
</stepset>
```

<path>

Description: The containing block for a set of <step>s within a branch.

Attributes:

name – The given name for the path.

Child Elements: <step>

Usage:

```
<stepset>
  <step>
    <para>Step 1. Create the stepset opening and closing tags</para>
  </step>
  <branch>
    <para>Choose if you want to complete the stepset with branches or not.</para>
    <path="With Branches">
      <step>
        <para>Add paths to your branch</para>
      </step>
    </path>
```

```
    <path="Without Branches">
      <step>
        <para>A path can be empty as well...just remove this step.</para>
      </step>
    </path>
  </branch>
  <step>
    <para>Step 3. FYI, You can add branches within paths.</para>
  </step>
</stepset>
```

<step>

Description: The containing block for a step – the base element in a <stepset> and a <path>.

Usage:

```
<stepset>
  <step>
    <para>Step 1. Create the stepset opening and closing tags</para>
  </step>
  <step>
    <para>Step 2. Fill the stepset with steps.</para>
  </step>
  <branch>
    <para>Choose if you want to complete the stepset with branches or not.</para>
    <path="With Branches">
      <step>
        <para>Add paths to your branch</para>
      </step>
    </path>
    <path="Without Branches">
      <step>
        <para>A path can be empty as well...just remove this step.</para>
      </step>
    </path>
  </branch>
  <step>
    <para>Step 3. You can add branches within paths.</para>
  </step>
</stepset>
```

<footNote>

Description: A tag for declaring document footnotes. The intent is that the footnote text is hidden from the reader (or placed elsewhere) as it would be in traditional publications.

Usage:

```
<para>You can write a sentence. You can also add a footnote<footNote>In the tivit
system footNotes will appear as super-scripted, incrementing numbers.</footNote>.
You can add footnotes anywhere there is regular text.</para>
```

<image>

Description: The containing block for an image. Authors are able to supply the image source and an alternative text to supply if the image is not found.

Attributes:

src – the image source location as it would appear for the HTM <img> tag.

alt – the images alternative text if the image is not found.

Child Elements: <caption>

Usage:

```
<image src="imgs/gattaca.jpg" alt="movie poster for a great film">
  <caption>Gattaca debuted in 1997. A story about a "genetically inferior man who
assumes the identity of a superior one" (IMDB).</caption>
</image>
```

<caption>

Description: A caption block to be added to an <image> or <thumbnail> element.

Usage:

```
<image src="imgs/gattaca.jpg" alt="movie poster for a great film">
  <caption>Gattaca debuted in 1997. A story about a "genetically inferior man who
assumes the identity of a superior one" (IMDB).</caption>
</image>
```

<thumbnail>

Description: The containing block for an image that will be displayed as an expandable thumbnail within the document.

Attributes:

src – the image source location as it would appear for the HTM <img> tag.

alt – the images alternative text if the image is not found.

width – the width at which the thumb-nailed image is to be presented.

height – the height at which the thumbnail-ed image is to be presented.

Child Elements: <caption>

Usage:

```
<thumbnail src="imgs/gattaca.jpg" alt="movie poster for a great film" width="200"
height="200">
  <caption>Gattaca debuted in 1997. A story about a "genetically inferior man who
assumes the identity of a superior one" (IMDB). Click the thumbnail to see the
full-size movie poster.</caption>
</thumbnail>
```

<select>

Description: A combo-box treated the same as an HTML <select> element. It is presented as a drop-down box with different choices.

Attributes:

id – The unique identifier for the instance of the select element.

Child Elements: <option>

Usage:

```
<select id="favoriteFood">
  <option value="pizza">Pizza</option>
  <option value="popcorn">Popcorn</option>
  <option value="rockies">Rocky Mountain Oysters</option>
  <option value="spinach">Spinach</option>
</select>
```

<option>

Description: An option as part of the the <select> tag.

Attributes:

value – An identifying value that can be used by the IETM logic or the JavaScript.

Usage:

```
<select id="favoriteFood">
  <option value="pizza">Pizza</option>
  <option value="popcorn">Popcorn</option>
  <option value="rockies">Rocky Mountain Oysters</option>
  <option value="spinach">Spinach</option>
</select>
```

<ifBlock>

Description: The containing block for a conditional display. If the condition (a evaluate-able Javascript expression) is met, the inner content is displayed.

Attributes:

condition – the evaluate-able JavaScript expression that is to be satisfied in order to present the ifBlock's content.

Child Elements: any

Usage:

```
<ifBlock condition="favoriteFood == 'spinach'">
  <para>Congratulations! Only cool people like spinach!</para>
</ifBlock>
```

<xlink>

Description: A link to an external URL that is outside of the tivit system.

Attributes:

uri – the URL of the external link

Usage:

```
<xlink uri="http://www.youtube.com/watch?v=33FVUJJyJqA ">Los Links!</xlink>
```

<ilink>

Description: A link to another IETM that can be viewed inside of the tivit system.

Attributes:

uri – the URL of the external link.

```
<ilink uri="items/How_To_Use_ILinks.xml">How to Link to other IETMs</ilink>
```

<ModuleRef>

Description: A link to an IETM module. Within the tivit system, an <IETMModule> that is clicked is loaded into the current IETM at the referenced location.

Attributes:

uri – the URL of the IETM Module.

Usage:

```
<para>ModuleRefs will need to be put on a line of their own in the IETM
document.</para>
<ModuleRef uri="ietms/alice_first_scene_change.xml">Making Your First Scene
Change</ModuleRef>
<para>This is because the loaded module will replace the ref - if it were put in
the middle of a paragraph not only would it look weird, but it might cause some
ugly problems.</para>
```

<flashvideo>

Description: A link to a hosted flash video (YouTube, Vimeo, DailyMotion, etc.).

Attributes:

uri – the URL of the flash video.

Usage:

```
<para><flashvideo
uri="http://www.youtube.com/watch?v=p99a6K81zqM">Comfort
Eagle</flashvideo> was the name of the song I was listening to when I did this
documentation.</para>
```


Description: Unordered list copied from the HTML element.

Child Elements:

Usage:

```
<ul>
  <li>Same</li>
  <li>As</li>
  <li>HTML</li>
</ul>
```


Description: A list item – same as HTML

Usage:

```
<ul>
  <li>Same</li>
  <li>As</li>
  <li>HTML</li>
</ul>
```

<para>

Description: Similar to the <p> element in HTML. Structured to hold and display sentences and other formatted text.

Attributes:

id – Unique identifier for the paragraph.

Child Elements: <text>

Usage:

```
<para>Just about anywhere you can put text, you can put a paragraph tag. Works
almost identical to a 'p' tag in HTML</para>
```

<text>

Description: A container for generic text that can be formatted and styled with HTML-based CSS.

Attributes:

style – The style attribute that holds CSS styling code.

Usage:

```
<text style="color:red; font-weight:bold;">Researchers say that red ink has
conditioned children to associate red with negativity.
(http://blogs.csun.edu/news/2010/06/red-ink/)</text>
```

<b>

Description: A shortcut bold tag.

Usage:

```
<para>Blah blah blah <b>Bold!</b> blah blah blah.</para>
```

<u>

Description: A shortcut underline tag.

```
<para>No one has told me to read <u>above the lines</u>, that is because most
people will do it automatically.</para>
```

<FrontMatter>

Description: The containing block for all pre-body content for an IETM document. It is an optional tag.

Child Elements: <TitlePage>, <CopyrightInfo>, <FrontNotes>, <SafetyInfo>, <TableOfContents>

Usage:

```
<FrontMatter>
  <TitlePage>
    <DocumentTitle>Proprietary Rights</DocumentTitle>
    <DocumentSubtitle>Suggesting That What Can Be Taught or Replicated Holds
Value</DocumentSubtitle>
    <DocumentAuthor>Thomas Edison</DocumentAuthor>
    <PubDate>December 07, 2010</PubDate>
  </TitlePage>
  <CopyrightInfo>
    <cblock>
      <para>Go ahead and copy this, I do not care.</para>
    </cblock>
  </CopyrightInfo>
  <FrontNotes>
    <para>Little did you know, there is no body to this document.</para>
  </FrontNotes>
</FrontMatter>
```

<TitlePage>

Description: The Title page for a more formal IETM publication.

Child Elements: <DocumentTitle>, <DocumentSubtitle>, <DocumentAuthor>, <DocumentID>, <PubDate>, <Publisher>

Usage:

```
<FrontMatter>
  <TitlePage>
    <DocumentTitle>Proprietary Rights</DocumentTitle>
    <DocumentSubtitle>Suggesting That What Can Be Taught or Replicated Holds
Value</DocumentSubtitle>
    <DocumentAuthor>Thomas Edison</DocumentAuthor>
    <PubDate>December 07, 2010</PubDate>
  </TitlePage>
</FrontMatter>
```

<CopyrightInfo>

Description: Holding tag for a formally structured copyright information page.

Usage:

```
<FrontMatter>
  <CopyrightInfo>
    <cblock>
      <para>Go ahead and copy this, I do not care.</para>
    </cblock>
  </CopyrightInfo>
</FrontMatter>
```

<PubDate>

Description: Specific tag for the publication date of the IETM.

Usage:

```
<FrontMatter>
  <TitlePage>
    <DocumentTitle>Proprietary Rights</DocumentTitle>
    <DocumentAuthor>Thomas Edison</DocumentAuthor>
    <PubDate>December 07, 2010</PubDate>
  </TitlePage>
</FrontMatter>
```

<Publisher>

Description: Specific tag for the publisher of the IETM.

Usage:

```
<FrontMatter>
  <TitlePage>
    <DocumentTitle>Proprietary Rights</DocumentTitle>
    <DocumentSubtitle>Suggesting That What Can Be Taught or Replicated Holds
Value</DocumentSubtitle>
    <DocumentAuthor>Thomas Edison</DocumentAuthor>
    <PubDate>December 07, 2010</PubDate>
  </TitlePage>
</FrontMatter>
```

<FrontNotes>

Description: Formal tag for any other content preceding the body of the document.

Usage:

```
<FrontMatter>
  <FrontNotes>
```

```
    <para>Little did you know, there is no body to this document.</para>
  </FrontNotes>
</FrontMatter>
```

<SafetyInfo>

Description: Formal tag safety information pertaining to the IETM document.

Usage:

```
<FrontMatter>
  <SafetyInfo>
    <para>COBOL may be bad for your health.</para>
  </SafetyInfo>
</FrontMatter>
```

<TableOfContents>

Description: The formal containing block for the Table of Contents (Somewhat deprecated). In the tivit system, the Sidebar TOC is used and the in-document TOC is hidden.

Usage:

```
<FrontMatter>
  <TableOfContents>
    <para>The TOC is automatically generated from at load-time. In the current
tivit implementation, it is also hidden.</para>
  </TableOfContents>
</FrontMatter>
```

<DocumentBody>

Description: The formal containing block for the body of the IETM document.

Child Elements: < Chapters>, <cblock>

Usage:

```
<IETMProduct>
  ...
  <DocumentBody>
    <Chapters>
      ...
    </Chapters>
  </DocumentBody>
  ...
</IETMProduct>
```

<Chapters>

Description: The containing block for the root-level chapters.

Child Elements: <Chapter>

Usage:

```
<DocumentBody>
  <Chapters>
    <Chapter>
      <ChapterTitle>Capitulo Uno</ChapterTitle>
      ...
    <Chapter>
    <Chapter>
      <ChapterTitle>Chapitre Un</ChapterTitle>
      ...
    </Chapter>
  </Chapters>
```

```
</DocumentBody>
```

<Chapter>

Description: The containing block for a section of information to be identified in the Table of Contents. Supports a sub-chapter structure.

Child Elements: <Chapter>, <ChapterTitle>, all

Usage:

```
<DocumentBody>
  <Chapters>
    <Chapter>
      <ChapterTitle>Kapitulua</ChapterTitle>
    </Chapter>
  </Chapters>
</DocumentBody>
```

<ChapterTitle>

Description: The title block for the chapter to be used in the Table of Contents at the head of the chapter.

Usage:

```
<DocumentBody>
  <Chapters>
    <Chapter>
      <ChapterTitle>Kapitulua</ChapterTitle>
    </Chapter>
  </Chapters>
</DocumentBody>
```

<EndMatter>

Description: The containing block for any post-body IETM content.

Usage:

```
<DocumentBody>
  ...
  <EndMatter>
    <cblock>
      Bad practice, but you can write text outside of para blocks.
    </cblock>
  </EndMatter>
</DocumentBody>
```

<Index>

Description: The containing block for an document/book index. Currently it is not used by the tivit system.

Usage:

```
<DocumentBody>
  ...
  <EndMatter>
    <Index>
      <para>The index block is not very well developed. Just a though for future
implementation if needed. So far, due to the quick access of info via IETMModules,
and the integrated search tool for internet browsers, an index is not really
necessary.</para>
    </Index>
  </EndMatter>
```

```
</DocumentBody>
```

<Glossary>

Description: The containing block for an document/book glossary. Currently it is not used by the tivit system.

Usage:

```
<DocumentBody>
  ...
  <EndMatter>
    <Glossary>
      <para>You know what was said about the Index block? ...ditto.</para>
    </Glossary>
  </EndMatter>
</DocumentBody>
```

<Appendix>

Description: The containing block for an document/book appendix. Currently it is not used by the tivit system.

Usage:

```
<DocumentBody>
  ...
  <EndMatter>
    <Appendix>
      <para>Technically, the Appendix can work just like a Chapter.</para>
    </Appendix>
  </EndMatter>
</DocumentBody>
```