

Developing an Experiment with GIFT: Then and Now

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Abstract. The Generalized Intelligent Framework for Tutoring (GIFT) is a domain-independent open-source intelligent tutoring framework. In the past new versions of GIFT were released every 6 months, and currently, officially tested versions of GIFT are released every 9 months. Each new version of GIFT includes additional capabilities and functionalities. In the current paper and presentation, the “Logic Puzzle Tutorial” course that was developed in GIFT 2.5, and has been included with releases of GIFT since version 4.0 will be discussed. The presentation will describe the rationale and methods behind the course’s development, and discuss different approaches that might have been used with the features that are present in GIFT today.

Keywords: Adaptive Tutoring, Intelligent Tutoring, Experimental Design, Course Development, Generalized Intelligent Framework for Tutoring, Psychology

1 Introduction

The Generalized Intelligent Framework for Tutoring (GIFT) is an open-source domain-independent intelligent tutoring framework [1]. Since GIFT is domain independent it offers great flexibility in the types of tutors and experiments that can be developed with it. While the development of adaptive tutoring systems is a primary objective of GIFT, it was also designed to be used as a testbed and for analysis purposes. Experiments can and have been developed and run using GIFT [2,3]. GIFT provides opportunities to create experiments that use adaptive feedback/assessment, and experiments that do not. In fact, GIFT is very useful as a mechanism to run traditional experiments in the area of psychology [4]. One such experiment was run as part of a Post Doctoral fellowship with Army Research Laboratory to investigate the impact of self-reference and context personalization on computer-based tutoring [3,5]. The skill that was taught to individuals was deductive reasoning, which was done through an interactive logic puzzle tutorial. The current paper discusses the development of the logic puzzle tutorial, and the different approaches that may have been taken had the current features of GIFT been available at the time.

1.1 Logic Puzzle Tutorial Experiment

The “Logic Puzzle Tutorial” course has been included with GIFT software releases since GIFT 4.0 in November 2013. This tutorial was originally developed for use in an experiment to examine the impact of self-reference on learning deductive reasoning skills and completing logic puzzles. The description and results of the original experiment are available in the form of an Army Research Laboratory technical report [5]. In the full experiment there were 3 versions of the logic puzzle tutorial. All of the versions were identical except for the names that were included in the puzzles and learning material. The names that were included were determined based on the condition, and the names that the participants were asked to type into the program. In the self-reference condition, the participant entered his or her name, and the names of 2 friends. In the popular culture condition, the participants were prompted to enter specific names of characters from the Harry Potter series. In the baseline condition, participants were asked to enter 3 provided names that were not common for their age group (based on birth name data). See Figure 1 for a screenshot comparison of the popular culture and baseline conditions.

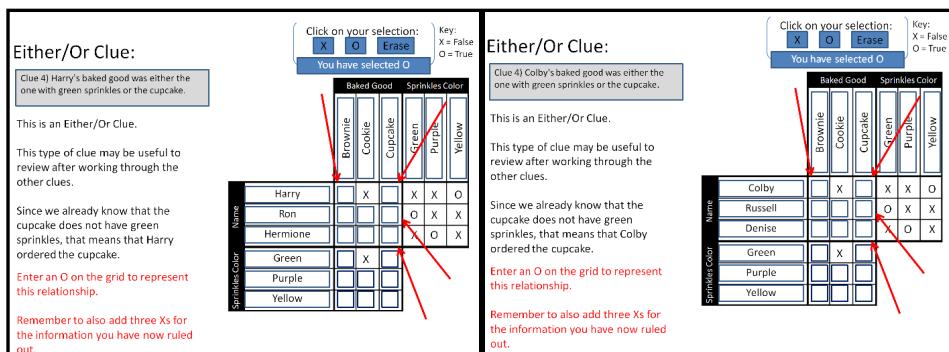


Fig. 1. Screenshots that demonstrate the manipulation of interest in the original logic puzzle tutorial experiment. Note that the names present in the puzzles and clues are different, with the Popular Culture condition on the left, and the Baseline condition on the right.

In the experiment, adaptive tutoring and feedback were provided to participants through a logic puzzle tutorial created in PowerPoint with Visual Basic for Applications (VBA). GIFT provided the interface that participants used for the study, presented surveys, opened and closed the PowerPoint based tutorial, launched web-page based questionnaires, and connected to a Q-sensor for physiological data collection. The original course was developed in GIFT 2.5, which was an experiment-based version of the November 2012 release of GIFT 2.0. Despite being developed in GIFT 2.5, the course is still compatible with current versions of GIFT (at the time of writing the most recent version is GIFT 2014-3X, which was released in December 2014).

1.2 Version of the “Logic Puzzle Tutorial” course included with GIFT

The released version of the “Logic Puzzle Tutorial” is a slightly modified version of the baseline condition tutorial from the original experiment and includes the names that were used in the experimental version. In this version, the tutorial automatically has the names present in it as opposed to prompting the user to enter them as in the experiment. The released version of the tutorial course includes a subset of the questionnaires and question based knowledge assessments that the participants answered. In the full experiment, after the completion of the tutorials the participants answered multiple-choice assessments, engaged in solving an “easy” puzzle and then a “difficult” puzzle. The released version of the course only includes the “easy” puzzle. See Figure 2 for a screenshot of the “easy” puzzle that is included with GIFT releases. Unlike the tutorial portion of the course, the “easy” puzzle does not include any adaptive feedback to the participants. However, the answers that are provided by the participant are saved to an external excel file for future analysis. There are two output files of interest for the researcher: 1) output of the surveys/questionnaires that can be accessed through GIFT’s Event Reporting Tool (ERT), and 2) Excel output of the puzzle which is saved in the Domain folder associated with the “Logic Puzzle Tutorial” course.

Clues		Click on your selection:						
		<input checked="" type="checkbox"/> X	<input type="radio"/> O	<input type="button" value="Erase"/>				Key: X = False O = True
Clue 1) The same person who ordered the cake ordered the pizza.								
Clue 2) The person who ordered the lemonade did not order the spaghetti.								
Clue 3) The three orders were: the one that ordered the tiramisu, the one with the pizza, and the one with the lemonade.								
Clue 4) Neither the person who ordered the cannoli, nor the person who ordered the spaghetti had the soda.								
Clue 5) Of the person who ordered the cannoli, and the person who ordered the cake, one ordered the ravioli, and the other had the soda.								
<p>*Please complete the grid and solve the puzzle. *Once you have finished it, click the blue forward arrow. *If you have not completed it in 10 minutes, it will move forward automatically.</p>								

Fig. 2. Screenshot of the “easy” logic puzzle that is included with the “Logic Puzzle Tutorial” course in GIFT.

2 Tools used in Course Development: Then and Now

GIFT contains a suite of Authoring Tools that can be used for course development. The tools that were used in the development of the original “Logic Puzzle Tutorial” course/experiment were the Course Authoring Tool (CAT), Sensor Configuration Authoring Tool (SCAT), and Survey Authoring System (SAS). Since the adaptive feedback occurred within the PowerPoint tutorial, a placeholder Domain Knowledge File (DKF) was used that did not result in adaptive feedback provided directly by GIFT. As GIFT has continued to develop, many of GIFT’s tools have been updated and have new functionalities in their current versions.

2.1 Course Authoring Tool (CAT) and GIFT Authoring Tool: Then and Now

The primary tool used for the development of the “Logic Puzzle Tutorial” was the CAT. The CAT allows the author to create a course flow that includes the order of guidance, training applications (e.g., PowerPoint), and surveys that the participant receives. Once design decisions have been made about the course and the components have been created, the CAT is where the transitions and flow of the course are specified. Figure 3 is a screenshot of the original “Logic Puzzle Tutorial” course loaded in the CAT. Note the linear structure of the elements, and the nodes that can expand to provide more detail.

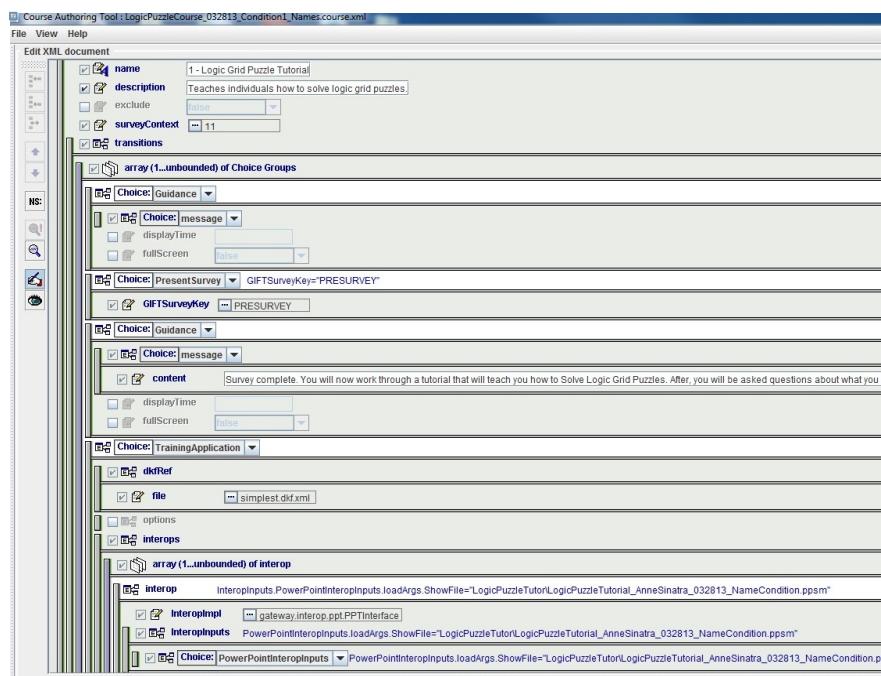


Fig. 3. Screenshot of the Course Authoring Tool that was used to create the “Logic Puzzle Tutorial” course.

The original XML (Extensible Markup Language) editor based CAT is still included with current releases of GIFT. However, an additional GIFT Authoring Tool (GAT) has been designed to allow an author to perform the same functionality in a more user-friendly interface. The same functionalities and course elements can be created using the GAT, but the interface is more straightforward and uses drop down menus that are closer matches for a general user's mental model than an XML editor based tool. A screenshot of the GAT with the "Logic Puzzle Tutorial" course loaded in it can be seen in Figure 4. While the redesign of this tool would not have impacted the design of the original course, it is expected that it would have led to a faster understanding of how to create the GIFT course.

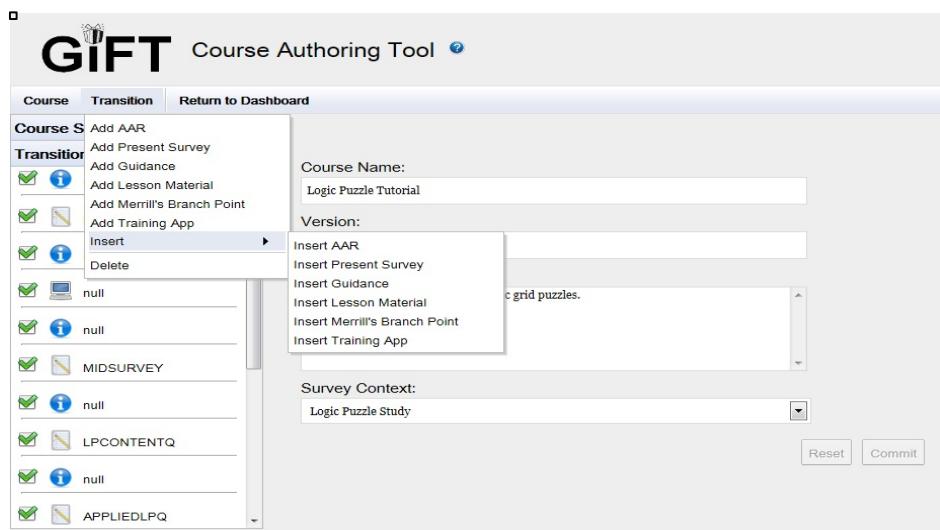


Fig. 4. The “Logic Puzzle Tutorial” course loaded in the GIFT Authoring Tool.

2.2 Survey Authoring System (SAS): Then and Now

The SAS was heavily used in the design of the “Logic Puzzle Tutorial” course. Many surveys including multiple-choice and multiple answer questions were created for use in the course. All of these surveys are available in releases of GIFT from version 3.0 to present, and many of these surveys are referenced within the “Logic Puzzle Tutorial” course. See Figure 5 for a screenshot of the SAS.

The screenshot shows the GIFT Survey System interface. At the top, there is a navigation bar with tabs: Question Bank, Surveys, Survey Contexts, and System. Below the navigation bar, there are three buttons: Create Question, Manage Shared Option Lists, and Manage Categories. A sub-menu titled 'Narrow Results' is open, showing categories: All, Fill In The Blank, Multiple Choice, Rating Scale, and Matrix Of Choices. Another sub-menu titled 'Category' is open, showing items: Immersive Tendencies Quest, Logic Puzzle Demographics, Logic Puzzle Post Questions, Logic Puzzle Tutor Content (which is highlighted in blue), Mood Rating, NASA-TLX, and Need for Cognition. To the right of these menus, a table lists questions with columns for ID and Question. The table contains the following data:

ID	Question
467	1) When you know a piece of information is true... Multiple Choice
468	2) Which of the following is NOT a component of Logic Grid Puzzles? Multiple Choice
469	3) What type of reasoning is used in solving Logic Grid Puzzles? Multiple Choice
470	4) When you know a piece of information is false... Multiple Choice
471	5) Which of the following is NOT a type of Logic Grid Puzzle Clue? Multiple Choice
472	11) It is never helpful to go through the clues more than once. Multiple Choice

Fig. 5. Screenshot of GIFT’s Survey Authoring System and a selection of questions associated with the “Logic Puzzle Tutorial” course.

The primary functions of the SAS have remained stable since the design of the original “Logic Puzzle Tutorial” course. However, there are now additional features that would be used. In the design of the original course the outputs of the questions were not automatically scored. Part of the reasoning behind this decision was that many of the scoring features were still in development at the time. Now the scoring features are stable and well documented in GIFT’s doc files. Additionally, course examples that use scoring can now be viewed and examined by authors to understand the scoring functionality. Weights can be assigned to the answers in the creation of questions, and surveys can be scored. Additionally, with the development of the Engine for Management of Adaptive Pedagogy (EMAP), question banks can now be created that are associated with specific concepts that the learner can be assessed on. The grading of surveys can now influence remediation that the individual learner is given. The functionality provided by the EMAP may have influenced the design of the logic puzzle tutorial experiment if it was created today, and may have ultimately led to a different experimental design. See Figure 6 for a screenshot of a survey context with a question bank in the SAS that is associated with the functionality of the EMAP. The development of the EMAP has been documented in the literature, which can be referenced for further reading [6,7].

Editing Survey Context - Excavator Training

Context Name:	Excavator Training		
Survey Key	Survey ID	Survey Name	
grit	69	Grit and Ambition Survey	<input checked="" type="checkbox"/> <input type="button" value="X"/>
midlesson	66	Excavator Controls Midlesson	<input checked="" type="checkbox"/> <input type="button" value="X"/>
motivation	65	Motivation and Strategies for Learning Questionnaire	<input checked="" type="checkbox"/> <input type="button" value="X"/>
self-regulatory	67	Self-Regulated Learning Strategies	<input checked="" type="checkbox"/> <input type="button" value="X"/>
Add Key			

Concepts Question Bank

▼ Arm (6)

Id	Question Text	
730	What are the four controls of the excavator?	<input checked="" type="checkbox"/> <input type="button" value="X"/>
731	What does the joystick on the right control?	<input checked="" type="checkbox"/> <input type="button" value="X"/>
740	Which joystick controls move the arm down?	<input checked="" type="checkbox"/> <input type="button" value="X"/>
742	Which control is labeled 'A' on the Excavator?	<input checked="" type="checkbox"/> <input type="button" value="X"/>
746	The arm is attached to what other component(s)? Select all that apply.	<input checked="" type="checkbox"/> <input type="button" value="X"/>
747	The Arm function is performed using the Right Joystick.	<input checked="" type="checkbox"/> <input type="button" value="X"/>

► Boom (5)

Fig. 6. Screenshot of a question bank associated with a Survey Context in GIFT 2014-2's SAS

2.3 The Sensor Authoring Tool (SCAT): Then and Now

The SCAT has remained fairly constant since the development of the “Logic Puzzle Tutorial” course. Like the CAT, it is an XML editor based tool. Default configurations for specific sensors are included with GIFT and authors can change the reference for the sensor configuration that will be used when they run GIFT. The sensor configuration is not linked directly to a course, but is used in all instances of the installation of GIFT unless it is adjusted between learners. Future versions of GIFT are expected to move toward making connections between the sensor configuration and the specific course that has been designed and run.

3 The Future

GIFT has gone through many iterations through the years, and at each point has added additional functionality and features. More additions and adjustments are expected as GIFT moves forward and in new directions, such as the cloud. One of the current goals of GIFT is to improve usability, which will make current and future features more understandable to all GIFT users. The “Logic Puzzle Tutorial” course which exists in GIFT is an example of using GIFT for an experiment. While it does not include adaptive elements based in GIFT, it offers a demonstration of how GIFT can be used for a traditional psychology experiment. The features of the more recent versions

of GIFT provide more flexibility and options to individuals who will be designing experiments in the future.

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