# Indicators are Key in Learning Argument Analysis

Maralee Harrell[1]

[1] Carnegie Mellon University, Pittsburgh, PA, U.S.A.

`mharrell@cmu.edu`

## Abstract

In an experiment involving 465 students in 26 different courses in the Fall of 2012, we investigated the effect of being able to identify parts of arguments on subsequent argument analysis tasks while taking the Carnegie Mellon University Argument Diagramming Online course. An argument diagram is a visual representation of the content and structure of an argument, and the Argument Diagramming Online course aims to teach students how to construct argument diagrams to aid in argument analysis tasks. The online course uses a large number of different kinds of interactive exercises. In the study, all of the students were enrolled in the Argument Diagramming Online course through their academic course. The results are that correctly marking exercises that ask for the user to determine identifiers is necessary for correctly marking later exercises and exam questions. The implication of this study is that, when teaching argument analysis and diagramming, teachers should focus more attention on students learning to use textual markers to identify parts of an argument.

## 1   Introduction

The past few decades have seen a tremendous amount of educational effort and research directed at the improvement of students' general critical thinking (CT) skills. The search for pedagogical methods that efficiently develop these skills is part of a growing national concern that our high school students are under-prepared for the rigors of college and that our college students are being well trained for particular industries, but inadequately prepared to be participating members of our democratic society (Perkins, Allen, & Hafner, 1983; Kuhn, 1991; Means & Voss, 1996).

There is a substantial amount of evidence that visualization, diagramming, and the use of graphic organizers in general are very effective learning aids. Both Larking and Simon (1987) and Winn (1991) argue that diagrams, compared to plain text, make information search and recognition faster and more efficient, and research on student learning has consistently shown the efficacy of using diagrams to aid text comprehension (Armbruster & Anderson, 1984; Dansereau, et al.; Novak & Gowin, 1984; Schwartz & Rafael, 1985), as well as vocabulary development, post-reading activities and writing preparation (Johnson, et al., 1986).

Research on computer-supported argument visualization by Tim van Gelder and others has shown that the use of software programs specifically designed to help students construct argument diagrams can significantly improve students' critical thinking abilities over the course of a semester-long college-level course (Kirschner, Shum & Carr, 2003; Twardy, 2004; van Gelder, 2001, 2003).

If we think of an argument the way that philosophers and logicians do—as a series of statements in which one is the conclusion, and the others are premises supporting this conclusion—then an argument diagram is a visual representation of these statements and the inferential connections between them. For example, consider the following argument:

> I think everyone would agree that life is worth protecting, and that the environment sustains all of us. It stands to reason, then, that we need to protect the environment. One particular threat to the

environment is the emission of greenhouse gasses. This is because greenhouse gasses trap the energy of the sun, causing the warming of the planet, and the warming of the planet could have catastrophic effects on the environment. So, we just can't avoid the conclusion that we need to reduce greenhouse gas emissions.

The reasons the author gives for believing this conclusion are the two premises: the fact that greenhouse gasses threaten the environment and the fact that we need to protect the environment. And the author gives further reasons for each of these premises. The way that all of these premises are inferentially connected to each other and the conclusion is what we call the structure of the argument.
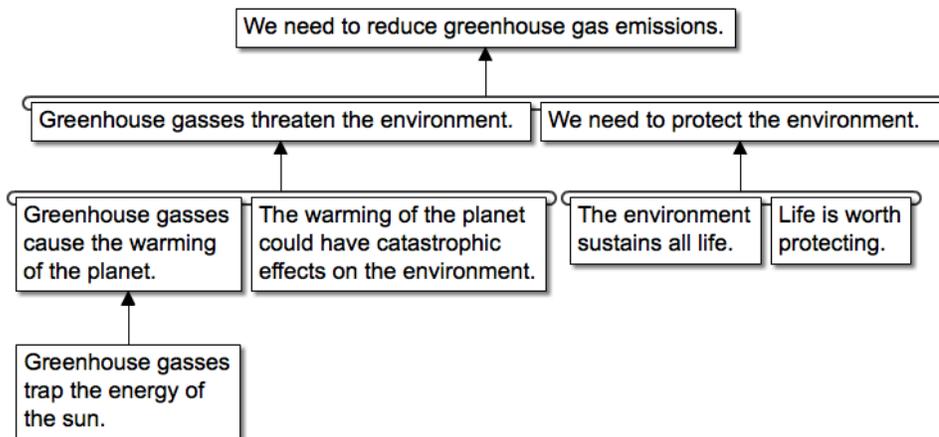


*Figure 1.* A diagram representing an argument for reducing greenhouse gas emissions.

I began to teach argument diagramming in the introductory philosophy course I teach every semester at Carnegie Mellon in 2004. I use diagramming mainly for assistance in the analysis and critique of arguments presented in primary source texts. At the start of the semester, I teach the students the basics of constructing diagrams to accurately reflect the arguments presented in the text. Then, the students are given short passages to diagram as homework throughout the semester.

The time it took to teach the basics of argument diagramming grew each semester. Thus, in 2007, in collaboration with Carnegie Mellon University's Open Learning Initiative (OLI), I began developing an online mini-course to teach students how to diagram arguments. It is a "mini-course" because it typically takes a student 4-6 hours to complete, and is usually assigned as one of the first homework assignments of the semester.

Over the past few years, more and more faculty at Carnegie Mellon have been assigning the OLI Argument Diagramming course as a homework assignment at the beginning of their courses. In the Fall of 2012, for example, 23 of 29 of the sections of our required first-year writing course used the OLI course as one of the first homework assignments.

## 2    OLI Argument Diagramming Course

The OLI Argument diagramming course presently consists of four units:
- Unit 1: Course Introduction
- Unit 2: Creating Argument Diagrams
- Unit 3: Evaluating Arguments
- Unit 4: Argument Diagramming for Interpreting Public Arguments and Longer Texts

Each of Units 2-4 contain text interspersed with interactive exercises. The users of the course learn the basic principles of argument analysis and diagramming in Unit 2. A free an open version of this course is available here: `oli.cmu.edu/teach-with-oli/review-our-free-open-courses/`.

One of the central features of this second unit reflects the belief that argument analysis includes at least being able to identify premises, conclusions, and inferences. This belief has lead us to devote a large portion of Unit 2 to learning to read an argument and recognize:

- Premise indicators
- Conclusion indicators
- Linked argument indicators, and
- Convergent argument indicators

Our hypothesis follows this belief. We conjecture that a good way to teach argument diagraming is to teach students to recognize these identifiers, and use them to determine the premises, (sub)conclusions, and inferences present in a given argument.

## 3    Method

The outline of Unit 2 of the OLI Argument Diagramming Course is given in the Appendix in Figure 2. In Sections 1-6 of Unit 2 of the OLI Argument Diagramming course, there are 64 interactive questions. Many of these questions have multiple parts, so there are 126 question parts altogether, before the Exam Readiness Quiz and the Final Exam. There are many varieties of interactive exercises, including:

- Submit and compare: the exercise asks the user for text or a diagram in response to a question. The user can then compare her answer to the model answer.
- Multiple Choice: the exercise asks the user to select one out of several possible answers to a question.
- Drag and Drop: the exercise asks users to identify parts of arguments by categorizing parts of statements.

The Exam Readiness Quiz consists in 30 questions chosen randomly from 3 pools of exam questions. The user is allowed 3 attempts at this stage. The Final Exam consists in 30 more questions, chosen from same 3 pools, but different from any of the questions used in the Exam Readiness Quiz. Types of exam questions include:

- *Choose best rewrite*: multiple choice exercise which asks the user to choose the best representation of the statements in an argument.
- *Identify structural indicators*: multiple choice exercise which asks the user to identify the premise, conclusion, linked argument, or convergent argument indicator in an argument.
- *Identify best argument diagram*: multiple choice exercise which asks the user to choose the argument diagram that best represents an argument.
- *Other*: identify the missing premise/conclusion in an argument, choose the best rewrite of a statement according to the principles of fairness and charity.

## 4    Participants

In the Fall of 2012, 465 students completed the OLI Argument Diagramming course for one of these classes:

- 76-101: Interpretation and Argument (416 students in 23 sections).
- 80-100: Introduction to Philosophy (16 students).

- 80-212: Arguments and Logical Analysis (16 students).
- 80-244: Environmental Ethics (17 students)

Data for each student's progress through the course is recorded by OLI, and then anonymized before being made available for analysis. Thus, we do not have demographic data for the participants (gender, etc.). However, since the vast majority of the participants were enrolled in the first-year writing course (76-101), which is required of all first-year students at Carnegie Mellon University, and the overall distribution of male and female students at Carnegie Mellon is 57% male and 43% female, it is reasonable to assume that the distribution among the participants is approximately 57% male & 43% female.

## 5   Results

Of the 126 question parts in Unit 2 of the OLI Argument Diagramming course (excluding the exam questions), 39 question parts asked the user to identify some type of indicator word or phrase in the argument—whether it was a premise indicator, conclusion indicator, linked argument indicator or convergent argument indicator.

In order to test our hypothesis, we tested whether marking any of these 39 indicator-word question parts correct was necessary for getting any of the subsequent question parts or exam questions correct. In other words, let one question part be QA, and another be QB. If marking QA correct is necessary for marking QB correct, then the likelihood (P) that a student marked the correct answer for QB is much higher than the likelihood of marking the correct answer for QB, given that she marked the answer for QA incorrectly. Thus, we calculated whether $P(QB=1) - P(QB=1|QA=0)$ was above some threshold delta for each question pair (QA, QB).

Fifteen of the 39 indicator-word question parts yielded a *significant* delta > 30% for some subsequent question part, and eight of these 15 yielded a *significant* delta > 30% for more than one subsequent question part. These results are summarized in Table 1. The content of these eight questions and the results for each are given in Tables 3 – 10 in the Appendix.

Table 1: For each indicator word question part (QA), the number of subsequent questions (QB) for which marking QA correct is necessary for marking QB correct.

| QA | Number of QB's |
|---|---|
| Question 13, part 1 | 4 |
| Question 24, part 2 | 12 |
| Question 32 | 3 |
| Question 34, part 2 | 19 |
| Question 39 | 11 |
| Question 43, part 2 | 12 |
| Question 45, part 1 | 7 |
| Question 47, part 2 | 5 |

The questions (QB's) for which these QA's were necessary are distributed among the question types noted in Section 3 above. Most of the QB's are also indicator word questions, but there are also a substantial number of QB's that are either "choose the best rewrite" and "identify the best argument diagram" questions. These results are summarized in Table 2.

Table 2: For all of the indicator word question parts in Table 1, the type of subsequent question (QB) for which marking QA correct is necessary for marking QB correct.

| | Choose best rewrite | Identify structural indicators | Identify best argument diagram | Other |
|---|---|---|---|---|
| Total number | 16 | 34 | 21 | 2 |

## 6    Discussion

Throughout the OLI Argument diagramming course, the interactive exercises aim to test the user's understanding of important concepts and skills. The exercises are meant to build on one another during the course, and later exercises will often ask very similar questions to earlier exercises. This helps the user retain the knowledge she has acquired by offering opportunities to transfer knowledge from one context to another.

It seems reasonable, therefore, to think that the user may not succeed on exercises in the latter part of the course, or on the exam questions, if she has not mastered some of the concepts and skills first introduced early on in the course. These results show that this is true for a  particular set of skills: the ability to recognize and interpret words and phrases that indicate the structure of the argument being analyzed. In particular, we focus on words and phrases that indicate premises, conclusions, linked arguments and convergent arguments.

From Tables 1 & 2, we can see that if the user has not developed the ability to recognize and interpret these indicator words and phrases early on, she will not mark subsequent exercises and exam questions of all types correctly. These key questions have been designated by QA in the tables above. For all the exercises and exam questions, labeled QB, in the tables, the likelihood that the user will mark QB correctly drops by at least 30% if they mark QA incorrectly. In fact, of the 73 QA/QB question pairs, for 50 pairs the likelihood drops by 30-40%, for 15 pairs the likelihood drops by 40-50%, and for 8 pairs the likelihood drops by over 50%.

It would be interesting to discover what it is about these particular questions that seem so crucial, especially in order to improve the course. For now, though, the message seems to be that learning to identify structural parts of arguments using textual indicators is a very important part of learning to analyze arguments.

References

Armbruster, B.B., & Anderson, T.H. (1982). Mapping: Representing informative text graphically. In Holley, C.D. & Dansereau, D.F. (Eds.), *Spatial learning strategies*. New York: Academic Press.

Dansereau, D.F., Collins, K.W., McDonald, B.A., Holley, C.D., Garland, J., Diekhoff, G., & Evans, S.H. (1979). Development and evaluation of a learning strategy program. *Journal of Educational Psychology*, 71: 64-73.

Kirschner, P.A., Shum, S.J.B., & Carr, C.S. (Eds.). (2003). *Visualizing argumentation: Software tools for collaborative and educational sense-making*. New York: Springer.

Kuhn, D. (1991). *The skills of argument*. Cambridge: Cambridge University Press.

Larkin, J.H., & Simon, H.A. (1987). Why a Diagram is (Sometimes) Worth Ten Thousand Words. *Cognitive Science*, 11, 65-99.

Means, M.L., & Voss, J.F. (1996). Who reasons well? Two studies of informal reasoning among children of different grade, ability, and knowledge levels. *Cognition and Instruction*, 14, 139-178.

Perkins, D.N., Allen, R., & Hafner, J. (1983). Difficulties in everyday reasoning. In W. Maxwell & J. Bruner (Eds.), *Thinking: The expanding frontier* (pp. 177-189). Philadelphia: The Franklin Institute Press.

Novak, J.D., & Gowin, D.B. (1984). *Learning how to learn*. New York: Cambridge University Press.

Schwartz, R.M., & Raphael, T.E. (1985). Concept of definition: A key to improving students' vocabulary. *Reading Teacher*, 39: 198-205.

Twardy, C.R. (2004) Argument Maps Improve Critical Thinking. *Teaching Philosophy*, 27, 95-116.

van Gelder, T. (2001). How to improve critical thinking using educational technology. In G. Kennedy, M. Keppell, C. McNaught, & T. Petrovic (Eeds.), *Meeting at the crossroads: proceedings of the 18th annual conference of the Australian Society for computers in learning in tertiary education* (pp. 539-548). Melbourne: Biomedical Multimedia Uni, The University of Melbourne.

van Gelder, T. (2003). Enhancing deliberation through computer supported visualization. In P.A. Kirschner, S.J.B. Shum, & C.S. Carr (Eds.), *Visualizing argumentation: Software tools for collaborative and educational sense-making* (pp. 97-115). New York: Springer.

Winn, W. (1991). Learning from maps and diagrams. *Educational Psychology Review*, 3: 211-247.

## 7 Appendix

| |
|---|
| **1. Introduction to Creating Argument Diagrams**<br>       Overview: Creating Argument Diagrams<br>       Introduction to iLogos<br>**2. Basic Vocabulary**<br>       Statements and Parts of Statements<br>       Arguments and Parts of Arguments<br>       Diagrams and Parts of Diagrams<br>**3. Understanding and Representing Argument Structure**<br>       Structural Indicators: Premises and Conclusions<br>       Multiple Statements within Sentences<br>       Linked Arguments<br>       Convergent Arguments<br>       Chain Arguments<br>       Complex Arguments<br>**4. Interpreting Arguments to Create Diagrams**<br>       Fairness and Charity<br>       Implied Premises and Conclusions<br>       Implied Premises and Conclusions: Complex Example<br>**5. Refutation**<br>       Diagramming Refutation<br>**6. Conclusion**<br>       Conclusion: Creating Argument Diagrams<br>**7. Final Exam: Creating Argument Diagrams**<br>       Exam Readiness Quiz: Creating Argument Diagrams<br>       Final Exam: Creating Argument Diagrams |

Figure 2: The outline of Unit 2 of the OLI Argument Diagramming Course

Table 3: The difference in the likelihood of a user marking question QB correctly vs. the likelihood of the user marking QB correctly given that she marked Question 13, part 1 (Q13, p1) incorrectly in the OLI Argument Diagramming course. P-values indicate the significance of the correlation between Q13, p1 and QB. Question 13, part 2 is given in Figure 3.

| QB | P(QB=1|Q13, p1=0) | P(QB=1) | delta |
|---|---|---|---|
| Exam Pool 3, Q10*** | 0.53 | 0.86 | 0.33 |
| Exam Pool 3, Q12*** | 0.39 | 0.77 | 0.38 |
| Exam Pool 3, Q31* | 0.27 | 0.57 | 0.30 |
| Exam Pool 3, Q46* | 0.33 | 0.66 | 0.33 |

* $p > 0.05$, ** $p > 0.01$, *** $p > 0.001$

| Select the premise or conclusion indicator in the following argument: *Soda is bad for you because it rots your teeth.* | | | |
|---|---|---|---|
| A. for | B. bad | C. because | D. rots |

Figure 3: Question 13, part 1

Table 4: The difference in the likelihood of a user marking question QB correctly vs. the likelihood of the user marking QB correctly given that she marked Question 24, part 2 (Q24, p2) incorrectly in the OLI Argument Diagramming course. P-values indicate the significance of the correlation between Q24, p2 and QB. Question 24, part 2 is given in Figure 4.

| QB | P(QB=1|Q24, p2=0) | P(QB = 1) | delta |
|---|---|---|---|
| Q25*** | 0.60 | 0.93 | 0.33 |
| Q28 p6*** | 0.48 | 0.83 | 0.35 |
| Q38*** | 0.44 | 0.83 | 0.39 |
| Q39*** | 0.47 | 0.84 | 0.37 |
| Q40*** | 0.60 | 0.92 | 0.32 |
| Q47, p2*** | 0.55 | 0.88 | 0.33 |
| Exam Pool 1, Q20** | 0.42 | 0.74 | 0.32 |
| Exam Pool 1, Q24** | 0.35 | 0.68 | 0.33 |
| Exam Pool 2, Q21** | 0.16 | 0.47 | 0.31 |
| Exam Pool 3, Q10*** | 0.42 | 0.86 | 0.44 |
| Exam Pool 3, Q35*** | 0.35 | 0.73 | 0.38 |
| Exam Pool 3, Q38*** | 0.44 | 0.79 | 0.35 |

\* $p > 0.05$, \*\* $p > 0.01$, \*\*\* $p > 0.001$

| Consider the following argument: *We need to take this animal somewhere to treat its injuries, but we can't take it home. So, I think we should take it to the vet.* Which of the following is the linked argument indicator? | | | |
|---|---|---|---|
| A. but | B. I think | C. should | D. so |

Figure 4: Question 24, part 2

Table 5: The difference in the likelihood of a user marking question QB correctly vs. the likelihood of the user marking QB correctly given that she marked Question 32 (Q32) incorrectly in the OLI Argument Diagramming course. P-values indicate the significance of the correlation between Q32 and QB. Question 32 is given in Figure 5.

| QB | P(QB=1|Q32=0) | P(QB=1) | delta |
|---|---|---|---|
| Exam Pool 2, Q9* | 0.50 | 0.89 | 0.39 |
| Exam Pool 2, Q17* | 0.00 | 0.83 | 0.83 |
| Exam Pool 2, Q29* | 0.25 | 0.73 | 0.48 |

\* $p > 0.05$, \*\* $p > 0.01$, \*\*\* $p > 0.001$

| Identify the convergent argument indicator in the following argument: There should be a standard format for all university websites. A standard format would make it easier for students to navigate web sites of schools to which they are interested in applying. Also, a standard format would make it easier for small schools to develop and maintain their own websites. | | |
|---|---|---|
| A. also | B. should | C. thus |

Figure 5: Question 32

Table 6: The difference in the likelihood of a user marking question QB correctly vs. the likelihood of the user marking QB correctly given that she marked Question 34, part 2 (Q34, p2) incorrectly in the OLI Argument Diagramming course. P-values indicate the significance of the correlation between QA and Q2. Question 34, part 2 is given in Figure 6.

| QB | P(QB=1|Q34, p2=0) | P(QB=1) | delta |
|---|---|---|---|
| Q35*** | 0.56 | 0.91 | 0.35 |
| Q38*** | 0.31 | 0.83 | 0.52 |
| Q39*** | 0.38 | 0.84 | 0.46 |
| Q40*** | 0.46 | 0.92 | 0.46 |
| Q47, p1** | 0.50 | 0.83 | 0.33 |
| Q47, p2** | 0.57 | 0.88 | 0.31 |
| Q52, p2** | 0.43 | 0.77 | 0.34 |
| Exam Pool 1, Q3* | 0.17 | 0.48 | 0.31 |
| Exam Pool 1, Q24* | 0.25 | 0.69 | 0.44 |
| Exam Pool 2, Q14** | 0.33 | 0.80 | 0.47 |
| Exam Pool 2, Q16** | 0.46 | 0.92 | 0.46 |
| Exam Pool 2, Q26* | 0.42 | 0.75 | 0.33 |
| Exam Pool 3, Q10 ** | 0.50 | 0.86 | 0.36 |
| Exam Pool 3, Q15** | 0.31 | 0.73 | 0.42 |
| Exam Pool 3, Q17* | 0.25 | 0.80 | 0.55 |
| Exam Pool 3, Q27* | 0.33 | 0.70 | 0.37 |
| Exam Pool 3, Q38** | 0.42 | 0.79 | 0.37 |
| Exam Pool 3, Q46* | 0.30 | 0.66 | 0.36 |

$* p > 0.05, ** p > 0.01, *** p > 0.001$

| Drag each marked part of the following argument into the correct column: [Politicians should not be trusted] [because] [they lie all the time.] [I know this because] [every time I see them on TV, they say something that just isn't true.] (Part 2 of this question is [because]) | | |
|---|---|---|
| Premise | Conclusion | Indicator |

Figure 6: Question 34, part 2

Table 7: The difference in the likelihood of a user marking question QA correctly vs. the likelihood of the user marking QA correctly given that she marked Question 39 (Q39) incorrectly in the OLI Argument Diagramming course. P-values indicate the significance of the correlation between Q39 and QB. Question 39 is given in Figure 7.

| QB | P(QB=1|Q39=0) | P(QB=1) | delta |
|---|---|---|---|
| Q47, p2*** | 0.57 | 0.88 | 0.31 |

| | | | |
|---|---|---|---|
| Q49, p1*** | 0.59 | 0.91 | 0.32 |
| Exam Pool 1, Q1*** | 0.58 | 0.90 | 0.32 |
| Exam Pool 1, Q13* | 0.50 | 0.82 | 0.32 |
| Exam Pool 1, Q16** | 0.00 | 0.84 | 0.84 |
| Exam Pool 1, Q19** | 0.00 | 0.80 | 0.80 |
| Exam Pool 2, Q1** | 0.59 | 0.91 | 0.32 |
| Exam Pool 2, Q11* | 0.50 | 0.82 | 0.32 |
| Exam Pool 3, Q5* | 0.50 | 0.94 | 0.44 |
| Exam Pool 3, Q41** | 0.43 | 0.74 | 0.31 |
| Exam Pool 3, Q49* | 0.50 | 0.87 | 0.37 |

\* p > 0.05, \*\* p > 0.01, \*\*\* p > 0.001

| Identify the premise indicator(s) in the following argument: If China attacks Taiwan, Taiwan will fight, for the Taiwanese are ready to defend themselves because their navy is well trained and well equipped. | | |
|---|---|---|
| A. for | B. because | C. for, because |

Figure 7: Question 39

Table 8: The difference in the likelihood of a user marking question QB correctly vs. the likelihood of the user marking QB correctly given that she marked Question 43, part 2 (Q43, p2) incorrectly in the OLI Argument Diagramming course. P-values indicate the significance of the correlation between Q43, p2 and QB. Question 43, part 2 is given in Figure 8.

| QB | P(QB=1|Q43, p2=0) | P(QB=1) | delta |
|---|---|---|---|
| Q44** | 0.16 | 0.54 | 0.38 |
| Q47, p2*** | 0.56 | 0.88 | 0.32 |
| Q50, p2*** | 0.47 | 0.84 | 0.37 |
| Exam Pool 1, Q3* | 0.00 | 0.92 | 0.92 |
| Exam Pool 1, Q24*** | 0.23 | 0.69 | 0.46 |
| Exam Pool 2, Q1* | 0.50 | 0.82 | 0.32 |
| Exam Pool 2, Q3* | 0.50 | 0.80 | 0.30 |
| Exam Pool 3, Q1* | 0.47 | 0.84 | 0.37 |
| Exam Pool 3, Q10*** | 0.56 | 0.86 | 0.30 |
| Exam Pool 3, Q26*** | 0.40 | 0.81 | 0.41 |
| Exam Pool 3, Q30* | 0.00 | 0.71 | 0.71 |
| Exam Pool 3, Q31** | 0.15 | 0.56 | 0.41 |
| Exam Pool 3, Q41* | 0.50 | 0.87 | 0.37 |

\* p > 0.05, \*\* p > 0.01, \*\*\* p > 0.001

| Drag each marked part of the following argument into the correct column: [Pool maintenance can cost hundreds of dollars a year] [and] [we really don't have that kind of money.] [So,] [I don't think we should put a pool in this summer.] [Besides,] [pools pose a real drowning danger to small children.] (Part 2 of this question is [and]) | | |
|---|---|---|
| Premise | Conclusion | Indicator |

Figure 8: Question 43, part 2

Table 9: The difference in the likelihood of a user marking question QB correctly vs. the likelihood of the user marking QB correctly given that she marked Question 45, part 1 (Q45, p1) incorrectly in the OLI Argument Diagramming course. P-values indicate the significance of the correlation between Q45, p1 and QB. An image of Question 45, part 1 is given in the Appendix in Figure 9.

| QB | P(QB=1|Q45, p1=0) | P(Q1=1) | delta |
|---|---|---|---|
| Q47, p1** | 0.50 | 0.83 | 0.33 |
| Q49, p1*** | 0.50 | 0.91 | 0.41 |
| Q56, p1*** | 0.44 | 0.86 | 0.42 |
| Exam Pool 1, Q20*** | 0.33 | 0.74 | 0.41 |
| Exam Pool 3, Q10** | 0.56 | 0.86 | 0.30 |
| Exam Pool 3, Q35* | 0.43 | 0.73 | 0.30 |
| Exam Pool 3, Q46* | 0.33 | 0.66 | 0.33 |

* $p > 0.05$, ** $p > 0.01$, *** $p > 0.001$

| Identify the conclusion indicators in the following argument: Either Boris drowned in the lake or he drowned in the ocean. But Boris has saltwater in his lungs, and if he has saltwater in his lungs, then he did not drown in the lake. So, Boris did not drown in the lake, and thus he drowned in the ocean. | | | |
|---|---|---|---|
| A. and, so | B. so, thus | C. but, and | D. thus, but |

Figure 9: Question 45, part 1

Table 10: The difference in the likelihood of a user marking question QB correctly vs. the likelihood of the user marking QB correctly given that she marked Question 47, part 2 (Q47, p2) incorrectly in the OLI Argument Diagramming course. P-values indicate the significance of the correlation between Q47, p2 and QB. Question 47, part 2 is given in Figure 10.

| QB | P(QB=1|Q47, p2=0) | P(QB=1) | delta |
|---|---|---|---|
| Exam Pool 1, Q24*** | 0.35 | 0.67 | 0.32 |
| Exam Pool 3, Q10*** | 0.51 | 0.86 | 0.35 |
| Exam Pool 3, Q31*** | 0.24 | 0.57 | 0.33 |
| Exam Pool 3, Q46*** | 0.34 | 0.66 | 0.32 |
| Exam Pool 3, Q48* | 0.00 | 0.83 | 0.83 |

* $p > 0.05$, ** $p > 0.01$, *** $p > 0.001$

| Consider the following argument: The defendant is guilty. After all, he confessed to stealing the jewels. In addition, he was undoubtedly present at the scene of the crime since his fingerprints are on the safe. Which of the following is the convergent argument indicator? | | | |
|---|---|---|---|
| A. furthermore | B. after all, since | C. after all | D. since |

Figure 10: Question 47, part 2