Identifying Deduction Abuse(s): A Shed of Light on Logic

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Abstract
This study aims at finding out and comparing students' ability in identifying abuse(s) in argument deductions between science students and social science students. The design of this study is a descriptive qualitative. There were 108 students involved as the respondents (52 science students and 56 social science students). The instrument utilized was ten arguments taken from Guth (1969), which is a specified test to drill argument analysis—aligning content validity for this current study. The respondents were asked to analyze these arguments and find out the deduction abuses. Their approach in analyzing each argument was further interpreted through data analysis. There were a total of 1080 analyses, but 477 analyses of which were discarded due to a biased approach. The data were analyzed using thematic and interactive analysis. The result shows that, among science students, the most employed approach is faulty premise (199 analyses), followed by misleading statistics (53 analyses), hidden premise (37 analyses), equivocation (10), and circular premise (4 analyses). Meanwhile, among social science students, the majority also exploited the faulty premise (137 analyses). Additionally, the hidden premise was also engaged in a great number (130 analyses), equivocation (40), followed by misleading statistics (9 analyses), and circular premise (2 analyses). These findings circumstantially imply that, in learning, students with a science background are better at capturing stated details, while students with a social science background are competent at spotting both stated and unstated details in arguments. It is suggested that teachers should balance the students' reasoning approaches, regardless of their academic backgrounds to achieve learning objectives.

Keywords: *logic, students' cognition, deduction, reasoning skills, and teaching and learning.*

1. Introduction

Reasoning skill is now profoundly demanded in life as people need to use various methodologies to overcome problems or simply to recall some random information in the middle of a conversation to maintain the relevance to the topic. Although all humans are born with it, reasoning ability is not something achieved without any effort. Continuous exercises are required to improve this capacity. Training our brain to exercise spurs memory and thinking. It also diminishes stress and anxiety and improves fixation and learning capability among students. Students who are engaged with critical thinking and problem-solving activities can develop reasoning skills in a more enhanced way (Kuhn and Udell, 2003). This is further supported by Agustyaningrum, et.al., (2019) stating that thinking is a mental cycle that is unique from one person to another. The most effective way to strengthen this skill is by utilizing it. The more it is used, the more advanced it becomes.

Reasoning is the ability of an individual to sort out information, reconstruct it, verify it, comply with realities, and normally revisit through some other information, data, and facts. Reasoning is the cognitive cycle of searching reasons behind beliefs, facts, conclusions, activities, or emotions (Kirwin, 1995). Two types of reasoning generally known are Inductive and Deductive reasoning. Inductive reasoning starts from details to build up the conclusion, while deductive reasoning is vice versa (Guth, 1969). In learning, the ability to think or give reasoning is a significant variable that influences performance. Reasoning promotes students to think in a complex but detailed way. Intelligent students reason differently from those less

intelligent since reasoning ability depends heavily on knowledge and expertise (Feltovich, Prietula, and Ericsson, 2006).

Lohman and Lakin (2009) urge that reasoning skill is never in a stagnant state. It either develops or deteriorates. It is also determined by a person's background knowledge and daily intelligent skills in performing daily tasks. Even in academic success, reasoning ability is required to comprehend various standards and principles, mathematical concepts, a variety of information, facts, and beliefs. The ability to perform reasoning is a fundamental competence for students that can empower them to adapt to the challenges throughout everyday academic life. It includes the capacities that can help them to solve problems, oversee unpredictability, and survive under any circumstances (Martinez, 2000). People have different abilities in terms of knowledge, intelligence, learning durability, and learning propensities. Good reasoning skill enables someone to discover the causes and effects of a problem and to proceed it to the solution. High reasoning ability demonstrates high learning capacity. The most fundamental principle in reasoning skill is realizing what to see and what to overlook in thinking about any issue. Effective learning requires reasoning strategies. Without a doubt, the most ideal approach to develop reasoning ability is through challenging students to practice old reasoning techniques and to design or learn new ones (Nickerson, 2004).

Regarding the significance of reasoning skills in academic performance, this study highlights the importance of analyzing students' ability in identifying flaws in arguments. When a person makes a conclusion, the conclusion should be believable so that it can be acceptable. However, this believability is relative from one person to another. The more logical a reasoning path is, the more believable a conclusion is. As stated by Guth (1969), major mistakes (abuses) can be made in making conclusions or deductions. There are five types of abuses that frequently happen when someone is deducing facts. They are faulty premises, hidden premises, equivocation, misleading statistics, and circular premises. Faulty premise is unreliable assumptions used to build up premises, leading to baseless conclusions. The examples are as in the following.

> *Students learn best in a relaxed atmosphere.*
> *The present system of exams induces tensions and anxieties.*
> *Therefore, exams work against true learning.*
> *(but is it true that a relaxed atmosphere is best for learning? do not at least some people perform better under pressure?)*
> *(Guth, 1969, p. 195).*

Next, its hidden premise. Hidden premises are implied meanings brought along with the premises and conclusion. See the example below.

> J*ones is a fascist. Don't listen to him.*
> *(Hidden premise: Fascists are not worth listening to)*
> (*Guth, 1969, p. 195*)

The next abuse is equivocation, which is shifting meaning during the course of argument. This usually happens in news known as 'clickbait', or to perplex the meaning of a word. See the following example: A person may use a flexible word, such as *radical,* to be employed in an economics textbook. In the beginning, the word *radical* may be interpreted as a person who wants to destroy the economics system, but when viewed more closely, the word *radical* only means a person who wants to revise an economics law. Hence, there is a meaning shift for the word *radical* (Guth, 196). Later, it is misleading statistics, which is a conclusion taken from the average statistics and being generalized to the overall subjects or population. For example, *Annual average income of people living in the Blueberry Park is $10,000. So that the residents in the Blueberry Park are affluent* (Guth, 196). Certainly, this average does not apply to all families. Suppose there are twenty families, there is still a possibility that nineteen of them earn only $2,000 per year and the other one—only one family—earn $162,000 per year.

The last one is circular. It is an argument that does not answer or clarify any facts. It needs the hearer/reader to do more questioning for clarification. See the example below.

C: The ball in the box is white.
D: Why?
C: Because it is white. (Hahn, Corner, and Oaksford, 2005).

Some previous research has been conducted on this topic. Thompson (1996) studied faulty arguments where she experimented on students to solve problems with believable, unbelievable, neutral premises, and whether the problems have believable or unbelievable conclusions. The result shows that conclusions with believable premises are more acceptable compared to those supported by unbelievable or neutral premises The other previous study mentioned here is a study by Khoiri and Widiati (2017). This study focused on identifying and discussing biased logical reasonings performed by Indonesian EFL learners in argumentative writing. They found that the students still produced a lot of logical fallacies, such as manipulation through language, manipulation through emotion, distraction, and induction conclusion (assumptions, oversimplification, overgeneralization, false analogy, faulty premise, and circular reasoning).

The literature elaborated above shows that there is still limited research conducted on logic to see the difference of reasoning styles between various disciplines, especially in language teaching. The novelty offered in this study is highlighting the act of comparing reasoning ability between different disciplines—in this case, science and social science. This study is considered significant since theoretically, it benefits the ontology of logic regarding its interrelation with language teaching discipline. Meanwhile, practically, the result of this current study can contribute to the advancement of language teaching as well as teaching material development. For instance, language teachers can have chances to improve their students' ability in reading or writing after identifying the students' thinking propensities. In an attempt to fill the gaps, the following research question was formulated:
"What type(s) of deduction abuse can dominantly be identified by science students and social science students? Does each student categorization employ a different reasoning approach?".

2. Method

This study was conducted under the principles of descriptive qualitative approach. There were 108 students voluntarily involved – 52 of whom were science students (Engineering major) while 56 of whom were social science students (Politics major). The instrument used was 10 arguments provided by Guth (1969) to test the ability to spot deduction abuses. The instrument was then distributed to the students to be analyzed. They were given 90 minutes to perform the reasoning analysis. After the data were gathered, data analysis was carried out.

There are two types of data analysis used in this study, namely thematic analysis and interactive analysis. The thematic is a recommended data analysis method by Wertz, et.al (2011). There are five stages in the coding procedure. First, it is classifying the information, in which the information from the types of abuses were separated based on the research questions. Then, it is verifying the information. After the data were classified into each category, the data were double checked to ensure that the data go into the correct categorization. Later, it is giving codes to each datum. Next, it is tabulating the information into its category whether they go into faulty premise, hidden premise, misleading statistics, or circular premise. Last, drawing conclusions from the data tabulation. Because there is no data display in the coding analysis, therefore, a different model of data analysis was required. The method proposed by Miles, Huberman, and Saldana (2014) consisting of three steps—data condensation, data display, and data verification—was used.

3. Results and Discussions

After analyzing the data, 477 students' tokens were discarded because of the fallacious reasoning. This is because this study does not attempt to figure out the types of fallacies that the students produced. This study focused on students' reasoning skill in spotting deduction abuses. The result is as shown below.

Table 1. Reasoning skill on deduction abuse between science and social science students

Student Category	Type of deduction abuse	Number of tokens	Discarded data (fallacious reasoning)	total analyses
Science	Faulty premise	199	245	520
	Hidden premise	53		
	Equivocation	37		
	Misleading statistics	10		
	Circular premise	4		
Social Science	Faulty premise	147	232	560
	Hidden premise	130		
	Equivocation	40		
	Misleading statistics	9		
	Circular premise	2		
Sum of tokens			**477**	**1080**

The table above shows that there are 1080 tokens gained from the respondents in total. However, because of unsuitable criteria with the data needed in this current study, 477 tokens were discarded. It can be seen that there are two categories based on the respondents' major: science and social science. The highest spot of science students in the deduction abuse is in the form of Faulty Premise (FP) as it is tracked from 199 tokens. Then, it is followed by Misleading Statistics (MS), which is reflected in 53 tokens. Next, it is Hidden Premise (HP) which can be found in 37 tokens. Later, it is equivocation (E) in 10 tokens, and the least is Circular Premise (CP) which was only spotted in 4 tokens. Looking at the social science category, the highest spot is also on FP (147 tokens). However, this category also has a high tendency in spotting HP (130 tokens). Then, it is followed by E (40 tokens), MS (9 tokens), and CP (2 tokens). Some of the students' analyses can be seen in the table of excerpt below. Tokens included are limited to item number 1, number 4, and number 9 for some formatting reasons. The excerpts were originally in Indonesian language, but for formatting reasons, they were translated into English. S-1 stands for Science Datum 1, etc; and SS-1 stands for Social Science Datum 1.

Table 2. Excerpts

Instrument item (Guth, 1969, p. 197-198)	Science	Type of abuse	Social science	Type of abuse
There are certain four-letter or Anglo-Saxon words which we could not accept in campus magazines. Our standard, as a university, is high. This is our main restriction: No four-letter word (Item 1).	*"Not all four-letter words have inappropriate meaning".* (S67).	*Equivocation*	*"If the four-letter word is banned, there should be an acceptable explanation for it".* (SS118).	*Hidden premise*
All members of the imperial bodyguard had to be at least six feet tall. Kim's grandfather was	*"There is not only one requirement. It*	*Faulty premise*	*"If he registered it means that he is tall enough. So*	*Hidden premise*

rejected when he tried to join the guard. He must have been too short (Item 4).	*is not only about height. He must have failed other criteria too".* (S501).		*that he is sure about his height. although he is not exactly 6 feet. But the word 'too short' is impossible for his rejection. He is may be 'short', but not 'too short'".* (SS558).	
When I went to see Professor Smith, he had a copy of the Daily Worker on his desk. He must be a communist (Item 9).	*"We cannot claim by first impression".* (S958).	*Equivocation*	*"May be all communists read the newspaper. But it does not mean Prof. Smith is a communist. He is a professor and there are numerous reasons for the newspaper to be on his desk such as research, extensive reading, and so on".* (S1009).	*Hidden premise*

From the excerpt seen in the table above, we can learn that one instrument item can be variously analyzed by the respondents using different logical analogical reasoning approaches. From what has been presented, there is a clear interpretation toward deduction abuses from the viewpoint of science students and from that of social science students. For more precise preview, the following graph is provided.

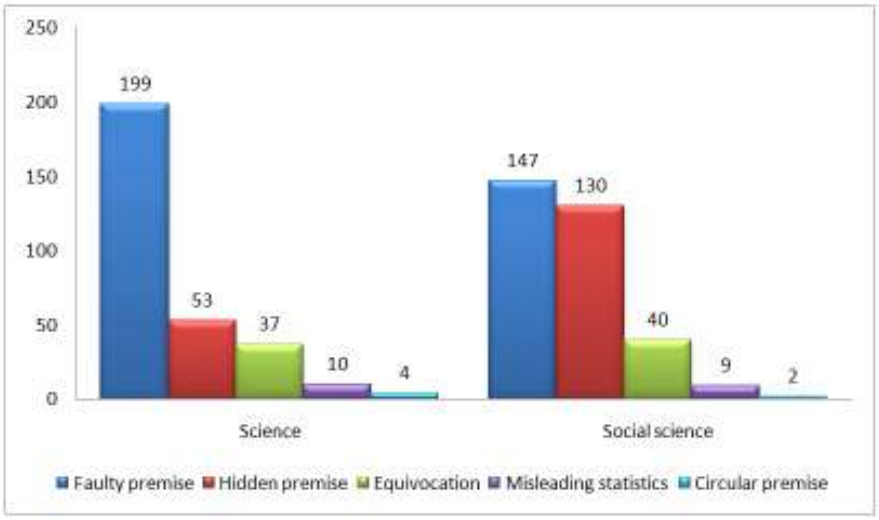

Figure 1. Comparison of Spotting Deduction Abuses

The figure above clearly shows that students with science background can spot more faulty arguments, followed by hidden premise, equivocation, misleading statistics and circular premise. Despite, indeed, students with social science background can also spot more abuses with faulty premises, but there is only a slight difference with the spotting of hidden premises. This finding is also supported by Yanto, Subali, and Suyanto (2019) in their experiment of

increasing students' ability in scientific reasoning: to analyze, to evaluate, and to create. From the pretest and post-test, it was found that the increase in analyzing and evaluating is higher than that of creating (the score increased from 20 to 100). This shows that the analysis which directly involves the acts of analyzing and evaluating such as spotting FP are easier for most individuals. This explains why both groups in this current study (science and social science) have the highest tokens in spotting FP. When it is further compared, science students perform better at spotting faulty arguments since they have 199 tokens of FP while social science students have 147 tokens.

Then, in spotting HP, science students only have 53 tokens while social science students have 130 tokens. This shows that the ability of spotting HP (or implied facts) is better performed by social science students. Bronkhorst, et.al., (2020) states that in performing reasoning, both logical and analogical reasoning approaches may be utilized. In determining hidden promise, analogical reasoning approach is used more and the respondents need to refer to entailing facts recalled from daily experiences and background knowledge. Galotti (1989) refers to this as an 'everyday reasoning task' which portrays more analogical than logical reasoning approach. Regarding the low HP approach used by science students, Rosdiana and Ismail (2017) stated that science students are more trained to cultivate information by 'decoding' rather than 'encoding'. They might have thought of implied facts carried along in the premise, but they could not narrate it communicatively and sequentially. Moreover, most of analyses made by the science students were precise, condensed, and short sentences, which is performed the other way

Around social science students. Additionally, science students rarely used hedgings (*might be, can, several, etc*) in their sentences, which makes their analyses come out as a closed analogy—there is no space for any other possibilities. This relates to communicative ability known as a passive language ability (Starfield, 1990).

Henceforth, employing various reasoning approaches is an important skill in an academic setting and teachers need to train their students on using it. By using both reasoning approaches, students can be more confident whether the conclusions they are offered with are valid deductions or only conjectures. Later, the other three abuses happened less frequently in both categories. This happened because there are minimum cases of equivocation, misleading statistics, and circular premise offered in the research instrument.

4. Conclusions

From the findings, it can be concluded that students with science background are better at performing reasoning skills by spotting faulty premises in arguments. Similarly, among social science students, highlighting faulty premises is also frequent. What differentiates between these two categories is that social science students can also see hidden premises in most of the arguments. Although this conclusion is contextual and further research needs to be conducted for more extensive generalization, this study has theoretically contributed to the domain of logic—which has possibilities to be applied in pedagogical disciplines.

The limitation that entails this current study is concerning the variant majors of respondents. The science students involved were all engineering students while the social science students were all politics students. Multidisciplinary approach is further needed in the categorization of science and social science. Future research is expected to cope with this limitation.

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