

An Analysis of Informal Reasoning Fallacy and Critical Thinking Dispositions among Malaysian Undergraduates

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Abstract

In this information age, the amount of complex information available due to technological advancement would require undergraduates to be extremely competent in processing information systematically. Critical thinking ability of undergraduates has been the focal point among educators, employers and the public at large. One of the dimensions of critical thinking is informal fallacy. Informal fallacy is able to distract us in thinking critically because they tend to appear as reasonable and their unreliability is not apparent on the surface. Empirical research affirms that critical thinking involves cognitive skills and dispositions. Critical thinking dispositions and informal reasoning fallacy are integral in facilitating students to have high ability in thinking critically. The aim of this paper is to measure the level of critical thinking ability among Malaysian undergraduates through the use of informal logic and critical thinking dispositions. A cross sectional survey was conducted on 189 samples of undergraduates from three different disciplines, testing them on newly developed Informal Reasoning Fallacy Instrument (IRFI) and California Critical Thinking Dispositions (CCTDI). A high reliability was achieved from both tests, with Cronbach alpha .802 for IRFI and .843 for CCTDI. Both tests projected good results among Malaysian undergraduates.

Keywords

Critical thinking disposition, informal logic, fallacy

Introduction

Critical thinking is neither the state-of-the-art scientific thinking nor it is a fad. It can be traced back to the early philosophies of Plato and Aristotle. In fact, philosophy itself revolves around critical thinking. Critical thinking has been recognized for many years as one of the primary aim of college level education. Educators and researchers agree that critical thinking can be nurtured. A component of critical thinking is termed as informal fallacy. Fallacies are erroneous thinking which deceives one's critical thinking. A good critical thinker would be able to detect these fallacies as well as reason them out, before concluding or deciding on certain matters. However, for a person to be critical, he has to be disposed toward thinking.

Therefore, the objectives of this paper are to (a) to gauge the informal reasoning fallacy ability among Malaysian undergraduates and (b) to identify Malaysian undergraduates' level of critical thinking dispositions.

Theories of Critical Thinking

The importance of critical thinking emerged in the modern era through a few theoreticians. Although there are various school of thoughts on critical thinking, similar underlying principles have been tackled.

In the context of understanding critical thinking, the father of modern critical thinking tradition, John Dewey claims that learners are aware of and control their learning by actively participating in reflective thinking – assessing what they know, what they need to know, and how they bridge that gap – during learning. Robert Ennis also agrees with Dewey that critical thinking is reasonable and reflective thinking focused on deciding what to believe or do (Ennis, 1985).

Glaser asserts that critical thinking is the "attitude of being disposed to consider in a thoughtful way the problems and subjects that come within the range of one's experiences; knowledge of the methods of logical inquiry and reasoning; and some skills in applying those methods" (p. 5-6, Glaser, 1941).

Halpern devised her own taxonomy of critical thinking which incorporates verbal reasoning skills, argument analysis skills, skills in thinking as hypothesis testing, likelihood and uncertainty, decision-making and problem solving skills (Halpern, 1998). Whereas, Richard Paul (1995) described critical thinking as a unique and purposeful thinking which is systematic and habitual.

The most recent theory on critical thinking is formulated by Peter Facione (1990) who considers critical thinking to be purposeful, self-regulatory judgment, which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based.

The Disposition Toward Critical Thinking

It is noted that critical thinking skills do not stand alone in order for one to become a good critical thinker. It needs to be accompanied by good habits of thinking which is termed as "*critical thinking disposition*".

Critical thinking disposition can be traced back to education philosopher, Robert Ennis, (Ennis, 1987) who defines it as a tendency to do something given certain conditions. In order to qualify as a thinking disposition, the disposition must be exercised reflectively.

Another education philosopher, Stephen Norris agrees that individuals must either have formed habits to use certain abilities, or overtly think and chose to use the abilities they possess. A person with an ability to think critically under certain conditions will do it, only if so disposed (Norris & Ennis, 1989).

According to Facione, Facione and Giancarlo (2000), the dimension of critical thinking disposition has seven conceptually non-discrete constructs which emphasizes on developing the habitual intention to be truth-seeking, open-minded, systematic, analytical, inquisitive, confident in reasoning, and maturity in making judgments. Dispositions are thought to be critical spirit, a probing inquisitiveness, and a keenness of mind that weak critical thinkers generally lack. A person can be positively or negatively disposed toward certain thinking skills but not toward all dispositions equally. (Facione, et al., 2001).

Truth-seeking involves intellectual integrity and a courageous desire to strive for best possible knowledge, asks probing questions, accepts reasons and evidences although they are against the persons' beliefs. Open-minded refers to a person who has tolerant divergent views

and sensitive to biases, a person who respects others' opinions. An analytical person is habitually alert to potential problems and alert in predicting consequences. A systematic person is always orderly, focused, persistent and diligent in problem solving. They are confident in reasoning skills which produces good judgments. A person who yearns to be well-informed and wants to know how things work are termed as inquisitive. A judicious person has cognitive maturity to distinguish between black and white as well as able to make judgments in an uncertainty context (Facione,2011).

Theories of Informal Logic

Introduction

Critical thinking involves logic. Logic is an approach in determining right from wrong reasoning which distinguishes good arguments from poor ones. Some people can arrive to the right conclusion for wrong reasons too. Psychological research findings show that in such complex, interconnected, dynamic decision situations, our brain is susceptible to 'reasoning errors' (Doerner, 1997). These reasoning errors are called fallacies.

Informal Reasoning Fallacies

The term fallacy originated from a Latin word, *fallacia*, from *fallac-*, *fallax* which means deceitful, or *fallere* to deceive (Webster Dictionary). Fallacies are sophisms or errors in reasoning which is connected with inferences as these errors sounds reasonable and valid, however their unreliability is vague. Informal fallacies are fallacies which are expressed in ordinary language and are common in everyday affairs which may be psychologically persuasive but logically flawed (Grcic, 2008). Walton closely connects the term fallacies and heuristics, which means short cut in thinking. Fallacies are highly persuasive, hence the widespread use in everyday dialogues. Informal fallacies act as tools for critical thinking (Walton, 2010; Rudinow & Barry, 2008).

Fallacies are known to have a psychological dimension in the pattern of illusions and deceptions. Fallacies violate argument rules used in rational thinking or argumentation (Walton, 2010). Besides Walton, van Eemeren and Grootendorst too claim that informal fallacies are elucidated for violations of the rules for dispute resolution through rational discussion (van Eemeren & Grootendorst, 1987). The term "*informal reasoning fallacy*" is used for arguments that are psychologically persuasive but logically incorrect. It persuades humans when it is not suppose to (Copy & Burgess-Jackson, 1996, p. 97).

Five popular fallacies were selected in order to gauge undergraduates' identification ability of informal reasoning fallacy.

Ad Hominem Fallacy

Locke identified ad hominem through Aristotle's *On Sophistical Refutations* as a strategy to downgrade someone with consequences resulting from his own principles and concessions.. Aristotle claims that rather than attacking the genuine error in the argument, it is answered in a twisted or inappropriate manner. Inappropriateness here refers to failure to relate to the context of the argument. Copi (1986) also contributed to irrelevancy by asserting that the character of a person is logically not relevant to the truth or falsehood of what he says or the correctness or incorrectness of his argument.

Ad hominem attack against a man is used to persuade others or to silence their opposition. However, Locke does not explicitly identify it as a fallacy, yet it may have fallacious occurrences depending on the appropriateness of the charge.

Other theoreticians believe that ad hominem fallacy is used as a sophistical tactic which concludes that a statement is false and backs it up with claims to attack. Nevertheless, the attacks are not addressing the worth of the statement which occurred in the argument but by discrediting a person's character or credibility (Lee, 2002; Duplass & Zeidler, 2000; Walton, 1998).

Circumstantial ad hominem is one of the ad hominem branches which accuses the victim as being bias, by using irrelevant personal circumstance about the person as evidence against the person's position. The arguer gains from the argument due to the victim's circumstances. It diverts people's attention from the argument to the person being attacked in the position (Rudinow & Barry, 2008). The following is the structure of circumstantial ad hominem:

1. A claims X.
2. B argues that A's claim is due to A's interest in the claim.
3. B makes an attack on A's circumstances.
4. According to B, X is false, which in fact is true.

Walton (1987) describes circumstantial ad hominem as the arguer who does not practice what he preaches, whereby the circumstance is inconsistent with the arguer's statements. In another tone, Walton claims that this type of argument is reasonable because inconsistency of an arguer's position should be open to criticism by questioning on the integrity of the arguer. However, it can be fallacious if the argument is rejected harshly or if the issue is evaded.

Other theoreticians challenge the traditional views that ad hominem are always fallacious. (Tindale, 2007; Mizrahi, 2010; Johnson, 2009; Woods, 2010). Tindale infers that the argument seems appropriate to focus into the person's character or circumstances when it has a direct support on the statement mentioned. Therefore, Tindale suggests to place the strategy for attacking an opponent under ethotic arguments. Ethotic arguments revolve around the speaker's character which has a link to Aristotle in his Rhetoric, where he observes that the character of the person is the mode of accepting an argument (Tindale, 2007). Which of the two views applies depends on the context in which the ad hominem argument is made (Michael, 2009). In order to be critical, one has to avoid attacking the person and focus on the falsehood of the argument instead.

Slippery Slope Fallacy

In informal logic studies, slippery slope is a specific causal fallacy which includes objection arising from unwarranted assumption which will lead to some negative consequences, eventually to even more negative consequences down the slippery slope until a disaster occurs (Rudinow & Barry, 2008; Rizzo, 2004).

Since this research focuses on informal logic, the type of slippery slope that I intend to discuss is the empirical (or psychological or causal) version. The empirical form tells us that the effect of accepting A will be that, as a result of psychological and social processes, we sooner or later will accept B (Burg, 1998).

Burg (1998) outlines it in an argument structure:

- If you take step A, due to sticky sequence of events, step B will necessarily or very likely to follow.
- B is not acceptable therefore you must not take step A.

Such arguments as the above structure are frequently regarded as mistaken, often on the grounds that they rely on speculative or insufficiently strong empirical premises (Douglas, 2010). Mc Kay professes that when predictions are made pertaining to some consequences of an action, one needs to specify the causal processes that produce those consequences. Wright (2000) claims that acknowledging the premise, taking actions or adopting policies will most probably lead to wrong or bad outcomes. “The ‘slope’ is ‘slippery’ because there are no plausible halting points between the initial commitment to a premise, action, or policy and the resultant bad outcome. The desire to avoid such projected future consequences provides adequate reasons for not taking the first step.” (p.197).

Volokh (2003) makes an important point about slippery slope which can be a helpful metaphor, but it could start by enriching our vision and ends by clouding it. He suggests to go beyond the metaphor and examine specific mechanisms which cause the phenomenon that the metaphor describes—mechanisms that connect to human reasoning. He notes that there is often a risk at the first step of the slippery slope. This need causes impatience to many. It is a claim that we ought not make a sound decision today, for fear of having to draw a sound distinction tomorrow. Accepting “ideas we hate” sooner or later lead to restrictions on “ideas we cherish”. A and B may be in a continuum where B in some sense more than A, a condition in any event be hard to define precisely. The more we believe that one step now may lead to other steps later, the more we may view such situations with concern. However, not all slippery slopes will end dangerously, hence not fallacious. Volokh advises to alert the public on slippery slope risks, which may be dangerous for certain groups because it may make them seem extremist. Slippery slope may, though not always, present real risk, but often enough that we shouldn’t ignore the possibility of such slippage.

Slippery slope arguments are inclined to indefinite and ill-formed argument. People can be swayed easily compared to modus ponens because it sounds suggestive in the absence of argumentative details (Lafollette, 2005).

Hasty Generalization

Hasty generalization exaggerates the statistical significance of evidence taken from a similar sample (Rudinow & Barry, 2008). It fails to see the limitations or exceptions to an argument by over representing the statistical data. This fallacy is developed when a generalisation is drawn from a sample of the population, however the size of the sample is too small to support the generalization or conclusion.

Philosophers called this fallacy as jumping too quickly to conclusion by not adequately supported by premises. Such arguments are often based on generalizations that are stereotypes like (Walton & Gordon, 2009; Johnson & Blair, 1977). Walton and Gordon (2009) generated five errors that fit the category of jumping to a conclusion: “(1) insufficient premises as evidence to prove a conclusion (2) fallacious argument from ignorance, (3) arguing to a wrong conclusion, (4) using defeasible reasoning without being open to exceptions, and (5) overlooking/suppressing evidence” (p.1).

Hurley (2003) deals with hasty generalization as a kind of inductive fallacy. When the sample is not representative of the population, then hasty generalization fallacy is committed. Hasty generalization violates the requirements of good reasoning in sampling theory, a component of statistics.

Duplass and Zeidler (2000) alleges that students commit this fallacy whenever they make or accept a generalization on the basis of a sample that is neither sufficiently large nor representative or randomly selected. At times, overemphasizing rare events that contain a greater impact yet underestimating the occurrences of common events could happen. Unrepresentative samples result due to relying too much on heuristic or short cut approaches to obtaining support for a situation.

Post Hoc Ergo Propter Hoc

In Latin, *post hoc ergo propter hoc* means “*after this, therefore because of this*” (Rudinow & Barry, 2008). *Post hoc ergo propter hoc* is also termed as “*false cause*”. Causal conclusions are based on correlations. This fallacy is committed when the arguer leaps to causal conclusion quickly, without considering other alternative evidences (Hurley, 2003, p. 135).

This fallacy is inferring that a particular event is caused by another event, because both the events happen one after another. Although it happens as such, it is insufficient to infer a causal relationship between these events. Damer, 2001 argues that a chronological relationship is only one of the indicators of a possible causal relationship. If temporal priority is the sole reason to indicate a causal relationship, then generally any event which precedes another may also have a causal relationship, which evolves many superstitious thinking. Such thinking is unable to distinguish between a coincidence and a causal relationship (Damer, 2001). Walton also agrees with Damer that it involves inference of causation from temporal succession alone (Walton, 1987, 1989).

The fallacious false cause, according to Copy and Burgess-Jackson (1996) can be schematically described as follows:

1. B occurs after A (“*post hoc*”).
Therefore (“*ergo*”)
2. B happens because of A (“*propter hoc*”).
So, A and B has a causal connection.

In order to evade false cause, one is required to identify or to avoid confusing necessary and sufficient causes or to distinguish causal relations from mere correlations (Carter,2005). Therefore, one should strip the situations of their contexts and inspect the logical structure, which is embedded in the context (Jungwirth, 1992). Walton & Gordon (2009) generated three critical questions matching the argumentation scheme in order to avoid falling into the trap of false cause fallacy:

- (a) Is there a true correlation between *A* and *B*?
- (b) Are there any reasons to believe that the correlation is more than a coincidence?
- (c) Are there any alternative factors, that are causing both *A* and *B*?

One who commits the post hoc fallacy argues in a way that fails to comply with the conditions of a good argument. The defect is using insufficient evidence in drawing conclusion. Its adequacy is achieved only if it is supported by convincing evidences (Damer, 2001).

False Analogy

An analogy is a comparison between two things or situations. Epstein defines reasoning by analogy as a comparison when it is part of an argument: we draw a conclusion on one side of the comparison, therefore, on another side we ought to conclude the same (Epstein, 2006).

Although analogies are inconclusive, they are powerful in reasoning about things that can be otherwise. The differences may seem overpowering than the similarities. However, it depends on whether there are more similarities or more differences (Corbett & Eberly, 2000).

False analogy is classified as inductive logic. Inductive arguments generate evidence for some conclusions. Since false analogy resembles inductive argument, it is sometimes called fallacy of weak induction (Carter, 2005).

An argument by analogy has the following form according to Jason (Jason, 2001).

1. A is like B₁, B₂, B₃,
2. B₁, B₂, B₃, all have property of P.
3. Therefore, A has P.

A is considered a subject, whereas B₁, B₂, B₃, are analogs. P is a projected property. In order to distinguish between a strong or weak argument by analogy, certain criteria should be met. Jason also claims that assuming all are equal, the more the dissimilarities between B and A, the weaker the inference. An inductive argument can be made stronger or weaker by the addition of extra premises. It is termed as false analogy when such an argument is too weak even to be plausible. False analogy ignores significant differences between the subject and the analog(s). In false analogy, the project property is more closely connected with the differences between the subject and the analogs rather than with their similarities. In order to determine whether an analogy is false or not, one requires knowledge of the subject being discussed.

The first two premises establish an analogy between some familiar phenomena. Since, the familiar phenomena have some additional properties, the new phenomenon will also have that property. Arguments by analogy are fallacious if they are more persuasive than they should be. It is a defect if the similarities that moulds the analogy are not related to the property that is at issue in the conclusion (Carter, 2005).

Since analogies can be deceptively persuasive, they appeal to our sense of imagination (Boss, 2010). Note that not all arguments using analogies are hazardous. Boss claims that its' success depends on the type and extend of relevant similarities and dissimilarities between the issues being compared.

As Rudinow and Barry explain, the argument is based on similarities which are not relevant to conclusion. They simplified methods in detecting false analogy by introducing only two steps: a) detect the differences between items compared in the analogy; b) detect the relevance of the stipulated differences (Rudinow & Barry, 2008).

Whereas Boss generated other means for evaluating arguments based on analogies:

- (a) Identify what is being compared;
- (b) List down the similarities.
- (c) Question whether the similarities are strong enough to support the conclusion.
- (d) Upon listing down the similarities, cancel off similarities which are irrelevant.
- (e) The lesser the similarities, the weaker the analogy.
- (f) List down the dissimilarities / differences.
- (g) Question whether are they relevant in ways that affect the argument.
- (h) The more the dissimilarities, the weaker the analogy is.
- (i) Next, compare the list of similarities and differences.

- (j) Question whether the similarities strong enough to support the inference.
- (k) Are the dissimilarities relevant in important ways?
- (l) Examine possible strong counteranalogies and finally determine if the analogy supports the conclusion.

Methodology

Procedure

A cross-sectional study began with a purposive sampling technique. Undergraduates in universities or colleges functioned as a sampling unit. Undergraduates were contacted through emails obtained from respective school heads and lecturers, describing the study with attached informed consent. A total of 259 students agreed to participate in this study by filling up two sets of tests. Undergraduates from various universities were administered with the Informal Reasoning Fallacy Instrument and the California Critical Thinking Dispositions Inventory via an online survey method using the surveymonkey.com website. There was no time limit provided as this is not a speed test. Students were allowed to make changes to their responses. Participation of all students in this study was on a strictly voluntary basis. Informed consent forms were provided to participants. Since participation is on a voluntary basis, they will be instructed to withdraw from answering the tests at any point of time during the administration. Respondents were informed that any information obtained from them or about them would be kept confidential.

Due to the missing and incomplete data from 70 students, the final sample consisted of 189 students. Demographic information was collected prior to administering the instrument. With regard to the demographic distribution of the sample, 63% (n = 119) of them were females and 37% (n =70) were males. The respondents ranged in age from 18 to 24 years old. Majority of respondents (69%) are pursuing their Bachelor's Degree, whereas 31 % of them are pursuing their Diploma. 58% of the respondents are in Humanities discipline, 25% in technical field and 17% in the science discipline.

Instruments

Informal Reasoning Fallacy Instrument (IRFI)

Informal Reasoning Fallacy test is a 50-multiple choice item test. It measures whether someone exhibits strong reasoning by being non-fallacious. Though MCQ is well known for being objective in terms of providing answers, this instrument is flexible in a sense that it functions as a Likert scale. A scoring rubric was developed which was adopted from Ricco (2007), Neuman (2003), Weinstock et al (2004). A score of 0 point means falling into the trap of fallacies with poor reasoning; 1 point indicates partial score due to not falling into the fallacy trap but provides reasonable reasoning; 2 points projects full score for not being fallacious and for providing strong reasoning. A range of 0 - 100 (50 items x 2points) points were set. Scores for the five sub-scales range from 0 – 20 points. The distracters were compiled based on the most frequently generated poor reasoning made by students via open ended questions from the first phase of instrument development. Each question may take approximately 1 - 2 minutes to answer.

The use of expert validation reinforced the items further. Two experts in the field of critical thinking provided their feedback on the content of the scenarios, the response choices, the

scoring rubric and the language used. The empirical validation section is the final step in instrument development study which validated the test.

Reliability represents the extent to which the indicators measure the same trait. It measures the degree whereby a group indicators of a latent construct is internally consistent on the grounds of how highly interrelated the indicators are with each other. It is inversely related to measurement error. As reliability increases, measurement error declines, thus the relationship between a construct and the indicators are greater (p. 636, Hair, et.al. 2010). Since an overall internal consistency of .802 was achieved for the overall total reliability, this indicates that the construct explains more of the variance in each item, hence the amount of error decreases. The reliability of the fallacy sub-scales were .593 for Ad Hominem Fallacy, .541 for Slippery Slope, .476 for Hasty Generalization, .582 for Pos Hoc and .306 for False Analogy.

California Critical Thinking Disposition Inventory (CCTDI)

The California Critical Thinking Disposition Inventory (CCTDI) is a 75-item attitudinal measure, which is designed for use with the general adult population which includes college-aged students (Giancarlo & Facione, 2001). It uses a 6-point Likert-type response format, ranging from 1 (Strongly Agree) to 6 (Strongly Disagree).

It measures whether someone habitually exhibits the mindset of an ideal critical thinker. In other words, it assesses test takers' consistent internal motivations to engage in critical thinking skills. CCTDI is used to measure the dispositional aspects of critical thinking by obtaining the participants indication of the extent to which they agree or disagree with the statements expressing beliefs, values, attitudes and intentions that relate to reflective formation of reasoned judgments. (Insight Assessment, 2009). It doesn't presume any college level content knowledge (Facione, et.al., 2000).

CCTDI assesses one's disposition to critically think in 7 main areas, which are; Truthseeking, Open-mindedness, Analyticity, Systematicity, Critical Thinking Self-Confidence, Inquisitiveness and Maturity of Judgment (Insight Assessment, 2009).

For each of the seven scales, the participants may score a minimum of 10 points to a maximum of 60 points. The interpretive guidelines for the scores are as follows; positive inclination of the characteristic for a score of 40 points and above, ambivalence toward the characteristic for a score between 31-39 points and disinclination or opposition toward the characteristic for a score of 30 points and below (Giancarlo & Facione, 2001). Accordingly, the overall CCTDI score can be computed by summing up the seven scale scores, which would then range from a minimum of 70 points to a maximum of 420 points. The interpretative guidelines of the scores are as follows; 'positive disposition' for scores of 280 and above, 'ambivalence' for scores that range between 211 and 279 and 'negative disposition' for scores below 210 (Tiwari, et. al, 2006).

Overall Cronbach's alpha obtained was .843. Sub-scale of Truthseeking generated an internal consistency of .680, Open-mindedness was .455, Analyticity contributed to .555, Systematicity .560, Self-Confidence .681, Inquisitiveness .656 and Maturity .722. Three sub-scales produced reliability slightly below .60.

Finding by Facione et. al. (1995) demonstrated .90 reliability on Cronbach Alpha with subscales ranging from .60 to .78. Another finding coincides with Giancarlo and Facione in 2001 whereby the internal consistency reveals that the Cronbach's alpha for the seven scales of

CCTDI range from .71 to .80, which is highly acceptable and shows that the items in this inventory consistently measures the same underlying construct (Giancarlo & Facione, 2001).

Emir (2009) found an overall reliability coefficient of the scale as .89 on CCTDI. The subscales Cronbach Alpha reliability ranged from .65 -.74. Whereas Rudd et. al (2000) claims that CCTDI's overall reliability (Chronbach's alpha) is .90 and subscale reliability scores from .72 - .80. Kyungrim et al (2006) obtained a Cronbach's alpha coefficient of 0.7847 on the translated version of CCTDI into Korean language.

It is noted that open-mindedness carries a reliability of .455, among the lowest. In defense to the low reliability of a sub-scale, a study conducted by Crawford (2002) among 164 baccalaureate nursing students reveals that the overall Cronbach's alpha reliability for CCTDI was .88, & subscales' reliabilities ranged from .33 to .76. Open-mindedness scored .45. Nevertheless, further reliability test will be carried out in the final collection of data with a bigger sample to determine its contribution.

Results

In this section, findings are discussed based on the objectives of the study: (a) informal reasoning fallacy ability among undergraduates (b) undergraduates' level of critical thinking dispositions based on sub-scales.

Descriptive Findings

(a) Objective 1: To gauge the informal reasoning fallacy ability among Malaysian undergraduates.

To address the first objective, a descriptive statistical analysis for IRFI was undertaken which yielded the following results. The mean on the overall IRFI instrument was recorded as 71.20 ($SD=10.88$). Six students scored below the mean score of 50, whereas 183 scored above the mean score. 25% of them scored 64 points and below, 50% scored below 73 points whereas 75% of the students were able to score below 79 points. The highest score was 91 by 2 respondents and the lowest was 41 points by 1 respondent. So the range is exactly 50 points.

Since the sample represented more than 50 respondents, Kolmogorov-Smirnov was used to detect its normality. It reported a significant level of .000, with a df of 189 which is considered as skewed distributed. The distribution of data has a slight negative skewness which is reported as -0.42 with an approximately platykurtic kurtosis of -0.56. Although the assumption of normality has been strictly rejected by using Kolmogorov-Smirnov, skewness and kurtosis indicate that the entire distribution is approximately normally distributed. Research has shown that the power of test is not affected by violations of normality assumption if the non-normality is solely due to skewness. In other words, kurtosis seems to have a greater impact on the power of statistics. However, the effect is more severe in a platykurtic than a leptokurtic distribution (Sharma, 1996). Since, the platykurtic is approximately 0, there is not much of an impact on the power of the test.

Table 1 shows a tabulation of frequencies and their percentages of respondents who scored above and below the mean score which is 10 for each sub-scales.

Sub-scales of Fallacies	Frequency of Respondents With Scores < 10 points	Percentage of Respondents With Scores < 50%	Frequency of Respondents With Scores > 10 points	Percentage of Respondents With Scores > 50%
Ad Hominem	31	16.4%	158	83.6%
Slippery Slope	15	8%	174	92%
Hasty Generalization	13	6.9%	176	93.1%
Post Hoc	34	18%	155	82%
False Analogy	29	15.3%	160	84.7%

Table 1: Frequencies and Percentages of Respondents' IRFI Scores Above and Below Mean Score

Table 2 tabulates the percentage of respondents who fell into the fallacy trap with a score of 0, 1 point for respondents who were not fallacious but were unable to reason very well and 2 points for those who were not fallacious and have high reasoning ability.

Sub-scales of Fallacies	0 point	1 point	2 points
Ad Hominem	15%	30.4%	54.6%
Slippery Slope	10.6%	25%	64.4%
Hasty Generalization	11.6%	27.7%	60.7%
Post Hoc	16.5%	28.2%	55.3%
False Analogy	19.4%	25.5%	55.1%

Table 2: Percentage of Respondents' IRFI Scores According to Sub-Scales of Fallacies

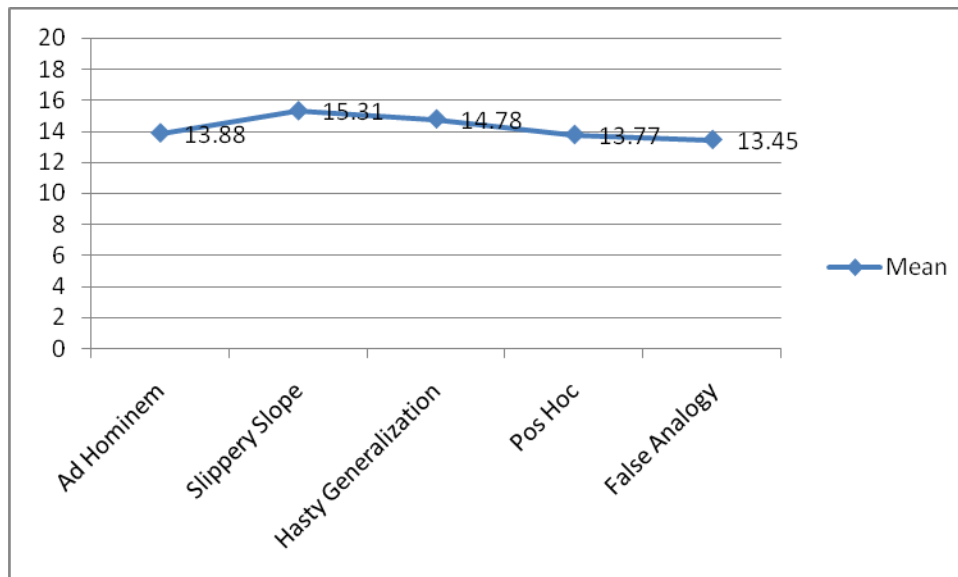


Figure 1: Profile of 189 Undergraduates on 5 Informal Fallacies

Based on Kolmogorov-Smirnov test of normality, the distribution of all 5 sub-scales are approximately asymmetrical. However, since the skewness and kurtosis revolve around 0, therefore, it could be noted here that all sub-scores of 5 fallacies are approximately normal.

Referring to the means in Figure 1, students' achievements in informal reasoning fallacy test for all sub-scales are approximately equal with means ranging from 13.45 – 15.31. Slippery Slope fallacy scored the highest mean (15.31), whereas False Analogy generated the lowest mean of 13.45. The spread in the distribution is between 2.70 – 3.41.

(b) Objective 2: to identify Malaysian undergraduates' level of critical thinking dispositions.

The composite score ranges between 70 to 420. Students who scored less than 210 are defined as negatively disposed, scores between 210 and 280 are ambivalent, and those who score above 280 are positively disposed toward critical thinking (see Facione, Facione et al., 1998; Giancarlo and Facione, 2001).

The samples fall approximately half into positive disposition and the other half under the ambivalence category. Eighty eight students (47%) scored above 280 points, which indicates positive disposition towards critical thinking, 101 (53%) scored between 210 and 280 which indicate ambivalence towards critical thinking. No respondents scored lower than 210, which indicate that there is no significant opposition to critical thinking.

Overall CCTDI score for 189 respondents generated a mean of 277.11 (*SD* of 24.39). The range is 137 between the scores of 226 to 363. Kolmogorov-Smirnov test successfully rejects the null of normality, which generated a normal distribution.

There are seven sub-scales in CCTDI. Each sub-scale provides a score between 10 - 60. Scores which range less than 30 indicates increasing negative disposition. Scales range from 30 – 40 is ambivalent and scores above 40 depicts increasingly positive disposition. However, Kolmogorov-Smirnov for the sub-scales of CCTDI reveals only Inquisitiveness and Maturity as normally distributed whereby $p > .05$. Nevertheless, by scrutinizing the skewness and the peakedness which revolve around 0, it is understood that all CCTDI sub-scales are approximately normal.

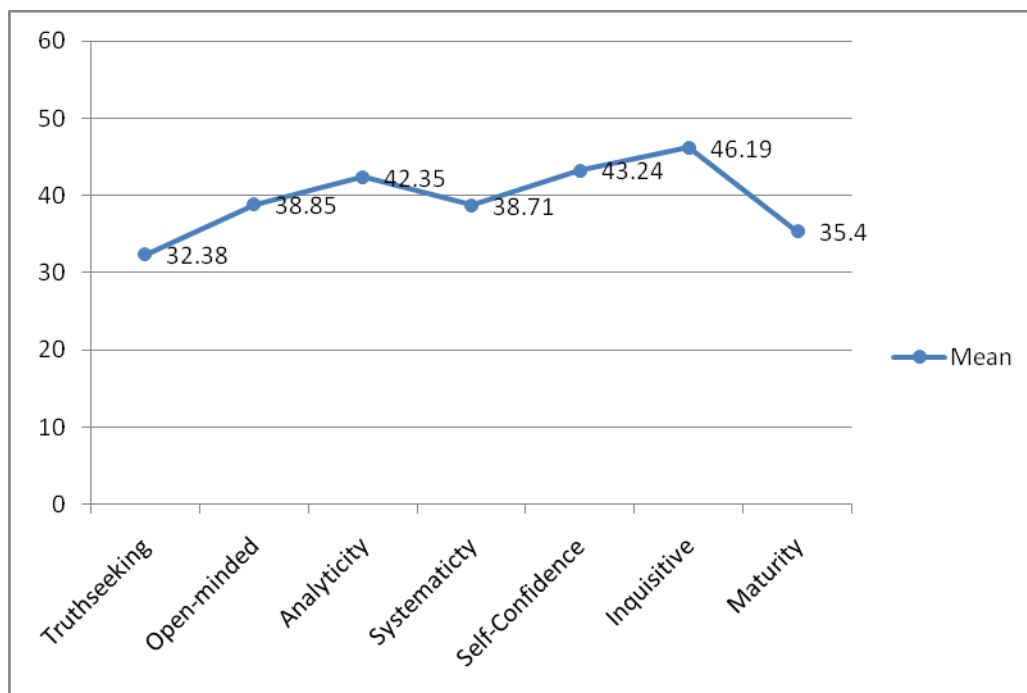


Figure 2: Critical Thinking Disposition Profile of 189 undergraduates on Seven CCTDI Sub-Scales

Figure 2 arrays graphically the ranges of sub-scale scores among 189 students. The mean scores are as labeled. Overall, students are prone to Analyticity, Self-Confidence and Inquisitiveness due to the mean exceeding 40 points and above, which depicts positive disposition. Students who are inclined to be inquisitive, have strong sense of intellectual curiosity. However, Truthseeking seems to obtain the lowest mean (32.38), which indicates that students are insensitive to strive for the best possible knowledge. They also seem to have less Maturity indicating non-judicious in making judgments. Judgments are made in the context of black and white.

Below is the table indicating the number of respondents whom are divided into three stipulated categories. 45.96% of the undergraduates are positively disposed, whereas 43.69% are ambivalent toward critical thinking disposition and only 10.35% are negatively disposed.

Subscales	Sub-scores less than 30 (Negative Disposition)		Sub-scores between 31-40 (Ambivalent)		Sub-scores more than 41 (Positive Disposition)	
	<i>N</i>	%	<i>N</i>	%	<i>And</i>	%
Truthseeking	67	35.45	108	57.14	14	7.41
Open-mindedness	8	4.23	114	60.32	67	35.45
Analyticity	2	0.92	63	33.33	124	65.75
Systematicity	11	5.82	116	61.38	62	32.80
Self-Confidence	3	1.59	52	27.51	134	70.90

Inquisitiveness	0	0.00	33	17.46	156	82.54
Maturity	46	24.34	92	48.68	51	26.98

Table 3: Number of respondents based on 3 categories of critical thinking disposition

Discussion

Interestingly, this study detected a vast majority of undergraduates who are able to reason well in everyday situations. Among the five types of fallacies, undergraduates scored the highest reasoning ability in hasty generalization and the lowest in post hoc fallacy.

In the context of being fallacious, again a huge percentage of Malaysian undergraduates were not fallacious. However, among those who fell into the fallacy trap, most students seem to slide into the false analogy fallacy followed by post hoc, ad hominem, hasty generalization and slippery slope respectively.

There are many reasons to support this false analogy slide. False analogy can be deceptively persuasive whereby it appeals to our sense of imagination according to Boss, 2010. It consists of much more effort than other fallacies in terms of evaluating the premises before reaching a conclusion. This is because false analogy requires thorough examination of similarities and differences between two situations, which are relevant to the conclusion prior to concluding or deciding in comparison to other fallacies (Rudinow & Barry, 2008).

On the overall critical thinking disposition scale, it can be said that Malaysian undergraduates are both moderate to positively disposed, which is a good sign for typical college students who are going to embark into the career world.

Further exploration of the CCTDI subscales reveals that Malaysian undergraduates are prone to be inquisitive which means being curious and eager to acquire knowledge even when the applications of the knowledge are not immediately apparent (Facione, Facione, & Giancarlo, 2000). This is a typical character of an educated person. This factor could be contributed most probably by the availability of information technology that is ever transforming, which are of reach to almost all students in this era.

On the other hand, truthseeking ability emerged as the lowest disposition. They have low courageous desire for the best knowledge, even if such knowledge fails to support or undermines one's preconceptions, beliefs or self interests. They are not prone to asking tough questions to seek knowledge. Low truthseeking ability also indicates that students are unwilling to follow reasons and evidence wherever they lead, and not willing to accept result which is contrary to one's own preconceptions and interests. Since Malaysians adopt the culture of collectivism, it could be one of the reasons why truthseeking is not prevalent. Many religious text and beliefs restrict this dispositional ability to be cultivated. This habit penetrates into the school and college systems as well. The lack of this disposition may be detrimental to informal reasoning ability which could be the reasons why some of the students scored low in the informal reasoning test.

The finding from this research concurs with Crawford (2002) who found that nursing students' highest mean score occurred in inquisitiveness (48.93), maturity (48.7), analyticity (46.26), openmindedness (45.03), systematicity (44.88), self-confidence (43.16) & truthseeking (39.08).

In summary, informal reasoning ability and critical thinking dispositions are essential tools in thinking critically. These tools can be nurtured in colleges in order to promote higher critical thinking ability. Further research is essential to detect the association between these two components of critical thinking.

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