**The Analysis of Informal Reasoning Fallacy and Critical Thinking**

 **Disposition 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. Poor critical thinking ability would hinder undergraduates in coping with everyday life situations that may lead them to become gullible citizens. One of the dimensions of critical thinking is informal fallacy, referred to as erroneous thinking. Critical thinking dispositions (CTD) and informal reasoning fallacy (IRF) are integral essence in facilitating students to have high ability in thinking critically. The objective of this study is to examine the performance of IRF ability and CTD among Malaysian undergraduates and also to determine the influence of undergraduates’ background variables to critical thinking. Relationship between IRF and CTD is determined to add to the deficit literature review. Data collection was gathered from 630 undergraduates. Findings reported that a moderate performance was yielded in IRF and CTD constructs. A significant relationship existed between the abovementioned constructs denoting that fallacy detection and CTD are crucial in order to be a critical thinker. Demographic variables were found not to be significant contributors to critical thinking, hence Malaysian undergraduates are not disadvantaged by their background in order to think critically. This discovery may shed light on educators to embark on critical thinking cultivation without the fear of how students’ background may impact the process of critical thinking in classrooms.

Keywords: Critical Thinking, Critical Thinking Disposition, Informal Reasoning Fallacy

**Introduction**

The rise of the ‘network’ society drives people to become more curious about information. The exponential development of urgent demand craves for skills to be uplifted in order to survive the avalanche of transformations taking place due to information explosion. Students are required to master multidimensional skills needed in the 21st century, such as critical thinking. Tertiary education is the transitional period or a period when the students have to deal with more challenging reading materials and complex concepts in order to be a good critical thinker. Are Malaysian undergraduates equipped with these abilities?

The objective of this study is to determine the performance of Malaysian undergraduates’ in informal reasoning fallacy (IRF) and the inclination toward critical thinking disposition (CTD).It is also aimed to determine the relationship between the two constructs. The third objective is to determine the influence of background variables on critical thinking.

**Informal reasoning fallacy**

In such complex, interconnected, dynamic decision-making situations, our brain is vulnerable to reasoning errors (Dorner, 1996). Reasoning errors are known as fallacy. Fallacies are known to have faulty arguments that appear to have true premises and sound conclusion thatfails to demonstrate truth in a conclusion of an argument (Govier, 1984; van Eemeren & Grootendorst, 1987; Stenberg, Roediger & Halpern, 2006; Gibbs, 2010). It is developed at an early age and continues to develop through tertiary education(Pascarella & Terenzini, 1991; Felton & Kuhn, 2001).

So, why are people trapped into fallacies? One of the reasons, according to Hamblin, Schmidt and Hansen (1986) is because people have psychological dimensions in the form of illusions and deceptions, also known to have high persuasive power, hence the widespread use in everyday discourse (as cited in Walton, 2010). On another note, fallacies relatecloselyto heuristics and defense mechanism(Paul and Elder, 2006; Walton, 2010). At times, the usage of fallacies may not be deliberate or conscious.

According to Paul and Elder (2006), the human mind is not inclined to seeking the truth yet reciprocates to flattery and brushes away threats and instinctively self-deceptive, they are naturally socio-centric as well. Therefore, in relation to the learning process, Marzano (2007) suggests the importance of identifying errors is to delve into declarative knowledge and claims that fallacies can be taught and exemplified.

This study focuses on five fallacies:

### Ad hominem

Ad hominem attack against a man is known as persuading people by silencing their opposition. Rather than attacking the genuine error in the argument, responses are answered in a twisted or inappropriate manner. The arguer has an upper hand in the argument owing to the victim’s circumstances because the attention is being diverted from the content of the argument to the circumstances of the person being attacked (Rudinow& Barry, 2007). Ad hominem is prevalent in political debate, and especially on Internet forums (Boudry, Paglieri & Pigliucci, 2015).

### Slippery Slope

Slippery slope is a causal fallacy whereby it includes objection on the basis of unwarranted assumptions and may lead to some negative impacts, eventually to more hazardous consequences until a disaster occurs (Van der Burg, 2009). There is no credible halting points between the initial premise and the repercussion (Wright, 2000). The need to avoid such future consequences provides sufficient reasons for not taking the first step (Rizzo & Whitman, 2003). Furthermore, Douglas (2010) claims that people with low epistemological level tends to get trapped in slippery slope fallacy because they are clouded with weak arguments.

### Hasty Generalization

Hurley (2010) defines hasty generalization fallacy as an argument that draws conclusions about all members of a group, from evidence that pertains to a selected sample’ (as cited in Walton, 1999, p. 142).Itviolates the requirements of good reasoning in sampling theory (Tindale, 2007; Woods, 2004). It can be said to have association to stereotyping, by lumping a group of people into a category due to the characteristic of a few (Avants, 2007; Schleger et al., 2011) and inadequate premise to prove a conclusion or claim (Walton & Gordon, 2009).

1. **Post Hoc Ergo Propter Hoc**

In Latin, post hoc ergo propter hoc means “*after this, therefore because of this*” (Rudinow & Barry, 2007). It is inferring to a particular event is caused by another event, because both the events happen one after another. It is insufficient to infer a causal relationship between these events. Hurley (2010) advises to seek alternative evidences rather than leaping to causal conclusion. However, its adequacy is achieved only if the argument is supported by convincing evidence (Damer, 2012).

### False Analogy

False analogy occurs asconclusions are drawn on one side of the comparison, therefore, on another side the same conclusion applies (Epstein, Kernberger & Raffi, 2002). However, it depends on whether there are more similarities or more differences (Corbett & Eberly, 2000). **Since two things are never perfectly identical, it requires critical evaluation and judgment to decide whether the comparison is valid for the context. If the comparison helps to give more accurate understanding, then it is valid (Cottrell, 2005).**

## Critical thinking disposition

CTD is an attitude of being disposed towards thinking critically. It is characterized as critical spirit that makes up of intellectually formed habits of mind to use certain abilities, complex attitudes and character traits (Ennis, 1987; Norris, 1992; Siegel, 1999).

CTD has numerouscharacteristics agreed upon by philosophers. A good critical thinker needs to be open-minded, honest, impartial while making judgment and wholeheartedin order to make reflections and actions (Dewey, 1997; Ennis, 1996; Siegel, 1988). Whereas, Paul (1991) establishes constructs for instance intellectual humility, courage, empathy, good faith, perseverance, faith in reason and sense of justice. Currently, the most prevalent philosophers in critical thinking regards disposition towards thinking as group of attitudes, intellectual virtues, and habits of mind that yielded a complete idea of critical thinking (Facione, Sanchez, Facione & Gainen, 1995).

Facione (1990) explains further that, “the ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit” (p.2). The following paragraphs elucidate seven constructs of critical thinking disposition designed by Facione et al. (1995, 2011).

* Truth-seeking involves intellectual integrity and a courageous desire to attempt for best possible knowledge, asks probing questions, acknowledges reasons and evidences although they are against the persons’ beliefs. In the context of truth-seeking among college students, a good truth-seeker will be inclined to adjust his or her beliefs in line with the presented facts and reasons, regardless of discipline majored. Truth-seekers are receptive to additional facts and evaluate them against evidences. In contrast, a non-truthseeker will fail to assess counter-evidence, hence rely solely on habits of what he or she has implanted rather than relying on evidence-based knowledge.
* Open-mindedness signifies tolerance of divergent views and sensitive to biases, one who respects the opinion of others, primarily for societies living in a multicultural country similar to Malaysia who are driven to tolerate and appreciate others’ lifestyles, culture, beliefs and practices. In addition, self-monitoring for possible biases are essential in order to be an open-minded person. In contrast, a close-minded will likely to result in clashes of opinions, verbal abuse and may also trigger physical abuse.
* An analytical person is habitually alert to potential problems and vigilant in anticipating consequences. They are watchful to problematic situations, appreciates reasoning and solving problems through evidences. An analytical person also foresees conceptual and practical difficulties and is always alert to interventions.
* A systematically disposed person is always organized in identifying and resolving problems. They are orderly, focused, persistent and diligent in problem solving. These traits are vital at all levels of complexities.
* Self-confidence in reasoning, indicates having trust in one’s reasoning skills in order to produce good judgments, i.e. perceiving oneself as a good critical thinker and able to guide others in making rational decisions.
* A person who aspires to be well-informed and understands how things work about various topics are termed as inquisitive. In view of intertwined information flowing across many disciplines, being inquisitively disposed aims to strengthen expert knowledge, competence and professional practice ability in the respective fields.
* Cognitively matured - one has to be judicious in distinguishing between black and white and judgments should not be made in an uncertainty context. Cognitively immature person views everything on a dual mode, i.e. true or false, black or white, right or wrong – insist on being rigid in seeing things. A matured person tends to tackle problems, inquire and make decisions assuming that the problems may be disorganized, uncertain which may need more than one credible option to solve or make decisions, especially in a time constrained state and in the absence of complete knowledge.

**Literature Review**

**Informal Reasoning Fallacy**

However, far too little attention has been paid to fallacies because the concept has been ingrained into critical thinking. Strong evidence was found that college students are able todetect fallacies, however expressed difficulties to resist andrationalize fallacies. They are confronted with hitches to anticipate the next possible move in fallacious argumentative dialogue (Neuman, 2003; Neuman, Glassner, & Weinstock, 2004; Weinstock, 2006; Ricco, 2007, 2011). Students were unable to identify and explain the same fallacy across various topics (Tarnoff, 2010). The finding was aligned with Weinstock, Neuman and Tabak (2004) reported that the ability to identify informal fallacies was at 62%; though respondents were only able to explain these fallacies as much as 38%. It implies that fallacy detection is less effortless than reasoning ability.

Findings in Tarnoff (2010) indicated that understanding each fallacy is crucial in order to justify why these fallacies are fallacious. Suggestions were proposed that colleges should foster the development of reasoning skills as part of an academic curriculum. Educationist should lever cognitive development of students beyond the contents of the course and create environments that foster and encourages critical thinking development. Importance should be given to teaching methods to cultivate critical thinking by abolishing didactic teaching and by engaging inquiry teaching method. Explicit instruction should be given to students through the context of engaging in activities that require these skills to be cultivated (Kitot, Ahmad & Seman, 2010).

**Critical Thinking Disposition**

Recent developments in critical thinking have heightened the need for investigation into the concept of critical thinking disposition especially in Malaysia. To begin with, based on Facione et al., (1995) California Critical Thinking Inventory (CCTDI), consistency is found in Inquisitiveness disposition, which seems to gain the highest mean score (Crawford, 2002; Shin et al. 2006; Begbie, 2007; Cohen, 2010; Wangensteen, Johansson, Björkström, & Nordström, 2010) and the lowest is Truth-seeking disposition (Facione et al. 1995; Qian & Pan 2002; Profetto-McGrath et al., 2009; Ku & Ho, 2010; Wangensteen, Johansson, Björkström, & Nordström, 2010). Cohen (2010) claims that nursing students with low scores in Truth-seeking and Open-mindedness may miss the clinical signs or symptoms that may have harmful consequences in treatments. The outcome of being close-minded may lead to lack of understanding on clinical implications, and avoid evidence-based research. Truth-seeking is necessary in the educational sector to facilitate discussions honestly, listening to each other’s opinions and sharing problems due to differences in the values of nursing students and current knowledge. In addition, one of the reasons of low mean scores could be the large class size that hampers the interaction with instructors.

Nonetheless, many studies have illustrated evidences that students are inclined to moderate and high CTD (Crawford, 2002; Qian & Pan, 2002; Begbie, 2007; Cohen, 2010; Wangensteen, Johansson, Björkström, & Nordström, 2010). However, some students are negatively inclined to CTD. Consensus was reached among the scholars that traditional teaching methods would have contributed to lower scores on CTD. It is suggested that new methods of teaching, instead of rote learning and better relationship between teachers and students may promote the tendency for these constructs further (Leaver-Dunn, Harrelson, Martin & Wyatt, 2002).

A Malaysian study revealed that students are unable to apply critical thinking in their schools or real world situation after 11 years of schooling (Rosnani & Suhailah, 2003).Instructors are required to adapt student-active learning models to nurture the curiosity and desire to learn (Björkström & Nordström, 2010; Wangensteen et al., 2010). It was suggested that presenting theoretical knowledge, scenario studies and giving exercises and homework may improve students’ CTD (Yildirim, Özkahraman & Ersoy, 2012). Levin and Wagner (2004) disclosed hard evidence that informal writing in Science subjects increased the students five dispositions toward thinking.

Rudd, Baker, and Hoover (2000) claims that there is a dire need to re-design instructional methods to improve agriculture students’ critical thinking. It is likely that didactic learning and the ‘one right answer’ syndrome influence poor Truth-seeking among students. Therefore, faculty should invoke safe atmosphere to voice out alternative opinions and rationale without fear of reprisal.

In the Asian perspective, Chinese education system relies more on knowledge rather than grooming attitudes to explore or deal with problems systematically. Hence, students tend to lose their self-confidence when they infiltrate into college life. Weaknesses in Open-mindedness and Systematicity could be contributed by the Chinese and South Korean homogenous nature with a closed, passive educational system based on prejudices and pre-decisions. Cognitive maturity is known to exhibit discretion in the process of decision- making by nurses. Poor achievement in cognitive maturity among nurses could be the result of being drilled to practice with standard situations, instead of providing freedom to make own decisions, so the development of students’ cognitive maturity of judgment is hindered (Ku & Ho, 2010; Shin et al., 2006).

Prior education (rote learning, dominant teacher-student relationship, lack of autonomy and responsibility, limited teaching strategies and the learning milieu) and cultural background (clinical learning environment) were blamed for the poor performance in CTD. Empirical evidence reveal that there are a number of promising teaching strategies for helping students develop CTD for instance dialogue, authentic instruction, and mentorship are effective techniques (Abrami, Bernard, Borokhovski, Waddington, Wade & Persson, 2015)

**Demographic Variables**

This study attempted to establish critical thinking across demographic information of respondents. Six demographic information were selected; gender, programme, major, year of study, socio-economic status and reading hours per week.

Findings from various studies presented no gender difference in critical thinking (Bessick, 2008; Chua, 2002; Laird, 2005; Tarnoff, 2010; Verawati, Arifin, Idris & Hamid, 2010; Leach, 2011). However, in several studies, males performed better than females in critical thinking (Rudd et al., 2000; Lundy et al., 2002; Wangensteen et al., 2010). Females outperformed males in these studies; (Wang & Yao, 2007; Tüfekci, Küçükoğlu, Bölükbaş &Tezel, 2011; Zhou).

In the context of discipline of study, a post hoc pairwise comparison analysis revealed a higher mean for majors amongPublic Health students compared to Nursing&Arts and Science (Leach, 2011).MarinandHalpern (2011) and Zhao et al., (2007) found significant difference in critical thinking among academic majors. Students from Science field scored higher in critical thinking than the non-Science fields due to problem solving nature in the Science field.Higher critical thinking scores were obtained for higher degrees (Deal & Pitman, 2009). Clark (2002) failed to find any statistical differences between the scores among Bachelor and Masters’ students in social work.

Diversity of experiences is a core criterion, especially in interacting with diverse peers and exposure to diverse curriculum. As the academic year progresses, challenges that are necessary for the development of critical thinkingstimulates mental development such as thought and reasoning process. Pascarella and Terenzini (1991) estimatedthat critical thinking grows at one standard deviation over an undergraduate education. However, Crawford (2002) indicated that critical thinking failed to increase significantly through each semester of the nursing program. It is being inferred that the curricular advancement failed to demonstrate an impact on students’ critical thinking abilities.Suliman (2006) found no significant difference between beginning and graduating nursing students. Cohen (2010) and Begbie (2007) found similar results for critical thinking disposition.

Socio-economic status plays an important feature in explaining differences in parental educational achievement and their children’s achievement in thinking. According to Cheung, Rudowicz, Lang, Yue, and Kwan (2001), among 577 Hong Kong University students, the influence of social class on students' critical thinking is very likely to occur. Findings conclude that students whose both parents possess college degrees had higher levels of critical thinking as compared to only one or neither (Deal & Pitman, 2009). Father’s levels of education were significantlyinfluencing critical thinking. Davis-Kean (2005) analyzed using structural equation modeling, that parents’ education was related indirectly to child’s achievement through expectations/beliefs. It is noted that students belong to upper class families excelled in critical thinking skills and disposition compared to students of lower classes. Upper class students have variety of tangible resources to directly facilitate studying and indirectly relieve burdens and obstacles to study. Regression equation predicts that father’s social class contributes to their children’s critical thinking as compared to their mothers. However, for disposition to thinking, both parents’ social class matters. Nevertheless, there was no significant difference reported on critical thinking skills of Turkish nursing students based on parents’ education and income level (Yildirim&Özsoy, 2011).

Critical reading cultivates critical thinking. Ozbay (2009) affirmed that reading is the most effective means of information in order to improve comprehension and thinking skills. Text comprehension significantly predicted students’ ability to identify fallacies among 184 high school students (Neuman, 2003). This highlights the necessity for students to have the ability of drawing inferences from texts. For instance, identifying a fallacious argument requires the skill to derive backwards inferences that connect the fallacious statement to earlier propositions in the text and to evaluate the relevance of the statement whether it was deduced from earlier propositions. In other words, it is to ascertain whether conclusions are derived from premises. The more students comprehended what they read, the better their ability to identify informal reasoning fallacies.

**Participants**

Using purposive sampling, six hundred and forty-three undergraduates consented to participate in this study. Of this total, 630 students (male 40.6% and female 59.4%) provided usable data. Mean age of undergraduates was 20.04. The majority of undergraduates were from technical field (47.90%) followed by humanities (20.5%) and science discipline (31.6%). All participation was on a voluntary basis. Those who participated in this research gave informed consent. Assurance was given to all participants regarding anonymity and confidentiality of the data.

Table 1

*Frequencies and Percentages of Respondents’ Demographic Data (n = 630)*

|  |  |  |
| --- | --- | --- |
| Demographic Variables | *n* |  *%* |
| Gender |  |  |
|  Male | 256 | 40.60 |
|  Female | 374 | 59.40 |
| Discipline of Study |  |  |
|  Humanities | 129 | 20.50 |
|  Technical  | 302 | 47.90 |
|  Science | 199 | 31.60 |
| Programme of Study |  |  |
|  Diploma | 269 | 42.70 |
|  Degree | 361 | 57.30 |
| Year of Study |  |  |
| Year 1 | 271 | 43.00 |
| Year 2 | 202 | 32.10 |
| Year 3 | 157 | 24.90 |
| Reading Hours per Week |  |  |
| < 5 hours | 272 | 43.20 |
| 5 - 10 hours | 205 | 32.50 |
| 10 – 15 hours | 54 | 8.60 |
| 15 – 20 hours | 36 | 5.70 |
| > 20 hours | 63 | 10.00 |
| Parents’ Highest Qualification |  |  |
| Primary | 91 | 14.40 |
| Secondary | 356 | 56.50 |
| Post Secondary | 117 | 18.60 |
| Degree | 50 | 7.90 |
| Post Graduate | 16 | 2.50 |
| Parents’ Annual Income |  |  |
| < RM 12,000 | 264 | 41.90 |
| RM12,000 – RM24,000 | 127 | 20.20 |
| RM24,000 – RM36,000 | 104 | 16.50 |
| RM36,000 – RM48,000 | 62 | 9.80 |
| >RM48,000 | 73 | 11.60 |

**Instruments**

**Informal Reasoning Fallacy Test**

Undergraduates were provided with 40 multiple choice dialogues on the IRF test. Five fallacies were tested across a range of forty scenarios, i.e. as hominem, slippery slope, hasty generalization, post hoc ergo propter hoc and false analogy. Performance of undergraduates within individual fallacies was dichotomized into poor (0 - 6), moderate (7 - 13) and high (14 - 20). The higher the scores on IRF test, the higher the reasoning ability and fallacy avoidance. The established reliability was .824 whereas the content validity was high.

**California Critical Thinking Disposition Inventory**

Participants were given 75 dispositional statements on the California Critical Thinking Disposition Inventory (CCTDI). The instrument comprises of 7 sub-scale; Truth-seeking, Open-mindedness, Analyticity, Systematicity, Critical Thinking Self-Confidence, Inquisitiveness and Cognitive Maturity. Composite score of CTD ranges between 70 to 420. Students who scored 210 and below are defined as negatively disposed. Scores between 211 and 279 are ambivalent and those who scored 280 and above are positively disposed toward critical thinking (CCTDI Test Manual, 2010). As for the sub-scales:

1. 40 points and higher indicates positive inclination or affirmation of the characteristic
2. 30 and lesser indicates opposition, disinclination or hostility toward that same characteristic
3. 31-39 points indicate ambiguity or ambivalence toward critical thinking disposition (Giancarlo & Facione, 2001)

The established reliability was .843. The grounding of the CCTDI in the Delphi study supports its validity (Facione, 1990).

**Results**

Research Question 1: How do undergraduates’ perform in IRF and inclined towards CTD?

Overall IRF score generated a mean of 47.46 (*SD =* 7.98) out of a possible score of 80, indicating that Malaysian undergraduates fare moderately in IRF. When dichotomizing into poor, moderate and high categories, 22.86% of them scored 80 points and above, which indicates high performance. Majority of undergraduates scored between 27 – 53 indicating moderate performancetowards fallacy. No respondents performed poorly on the total score of IRF.Table 2 outlines the mean, standard deviations and percentages of IRF.

Table 2

*Means, Standard Deviations and Percentages of Informal Reasoning Fallacy (n = 630)*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  | *Percentages* |  |
| *Informal Reasoning Fallacy* | *Mean* |  *SD*  |  *Poor* |  *Moderate* |  *High* |
| Ad Hominem | 9.23 | 2.51 | 15.08 | 80.16 | 4.76 |
| Slippery Slope | 8.80 | 2.43 | 19.37 | 78.10 | 2.54 |
| Hasty Generalization | 8.54 | 2.23 | 19.05 | 80.79 | 0.16 |
| Post Hoc | 11.86 | 2.98 | 3.49 | 67.30 | 29.21 |
| False Analogy | 9.04 | 2.61 | 16.51 | 79.37 | 4.13 |
| Total | 47.46 | 7.98 | 0 | 77.14 | 22.86 |

The means for fivefallaciesdisclosedmoderate performance, ranging from 8.54 to 11.86. Post hoc ergo propter hoc fallacy scored the highest mean of 11.86 (*SD* = 2.98), whereas hasty generalization generated the lowest mean of 8.54 (*SD* = 2.23). Most of the students (29.21%) were able to detect post hoc fallacies and provide justification for it. The most difficult fallacy detection was hasty generalization (*M*= 8.54; *SD*= 2.23).

Whereas, composite score on CTD yielded a mean of 259.23 (*SD =* 17.95), inclined to ambivalent. In addition, nearly 83 (13.17%) of them were inclined to positive disposition towards critical thinking. Majority of undergraduates (86.83%) were ambivalently inclined. However, none of the respondents were reported as having negative tendency towards CTD. Table 3 outlines the mean, standard deviations and percentages of CTD.

Table 3

*Means, Standard Deviations and Percentages of Critical Thinking Dispositions (n = 630)*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  | *Percentages* |  |
| *Critical thinking disposition measure* | *Mean* | *SD* | *Negative* | *Ambivalent* | *Positive* |
| Truth-seeking | 29.03 | 4.67 | 63.02 | 35.39 | 1.59 |
| Open-mindedness | 36.39 | 3.84 | 5.56 | 76.03 | 18.41 |
| Analyticity | 40.28 | 4.18 | 0.95 | 43.81 | 55.24 |
| Systematicity | 36.64 | 4.15 | 4.13 | 73.01 | 22.86 |
| CT Self-confidence | 41.68 | 5.47 | 2.70 | 27.14 | 70.16 |
| Inquisitiveness | 43.79 | 5.14 | 0.16 | 19.21 | 80.63 |
| Cognitive Maturity | 31.59 | 5.63 | 42.86 | 48.57 | 8.57 |
| Overall Critical Thinking Disposition | 259.23 | 17.95 | 0 | 86.83 | 13.17 |

The most striking results to emerge from further analysis of the data is that undergraduates are negatively inclined towards Truth-seeking disposition; the lowest among seven dispositions (*M* = 29.03, *SD* = 4.67).Three dispositions are ambivalent; Open-mindedness, Systematicity and Cognitive Maturity. Respondents achieved positive inclination for three dispositions (Inquisitiveness, Critical Thinking Self-Confidence and Analyticity) although the mean score were slightly above the border mark. Majority of the undergraduates were highly inquisitive, the highest percentage gained by respondents in comparison to remainder six dispositions, followed by CT Self-Confidence.

**Research Question 2**

To what extent does CTD predicts IRF among undergraduates?

A Pearson correlation was performed to determine significant relationship between IRF and CTD. Results indicated a significant positive correlation, *r*(628) = .313, *p* = .001. Correlation matrix depicts that the sub-scales of IRF and CTD has significant relationships for most of the pairs except for Critical Thinking Self-Confidence.

Further analysis was done using a simple linear regression. Regression model fits the data, hence there is a significant contribution of CTD towards IRF(Adjusted *R*2 = .096,*F*(1,628) = 68.000, *p* = .001, *Beta* = .313, *t* = 8.246, *p* = .001). Descriptive result indicates a small coefficient of determination, suggesting only 9.6% of the variance in the IRF is being explained by CTD.

**Research Question 3:**To what extent do undergraduates’ background variables influence critical thinking.

Multivariate analysis was employed to analyze the influence of background variables on critical thinking. Both IRF and CTD resulted in a non-significant gender difference; Pillai’s Trace = .002, *F* (2,627) = .639, *p* = .528. However, significant differences was reported for programme of study (Diploma & Degree), Pillai’s trace = .020, *F* (2,627) = 6.479, *p* = .002. Univariate results indicate that there is a significant difference between programmes on CTD, *F* (1,628) = 12.492, *p* = .001. CTD reveal higher mean for Diploma (*M* = 262.13) than the Degree undergraduates (*M* = 257.06). However, there was no significant differences found in IRF across programme of study, *F* (1,628) = 3.054, *p* = .081.

It was found that discipline of study is statistically significant across both the dependent variables; Pillai’s Trace = .023, *F* (4,1254) = 3.630, *p*= .006.An examination of univariate analysis resulted in a significant difference among disciplines of study on CTD; *F* (2,627) = 5.984, *p* = .003. Analysis of Tukey’s post hoc test reveals a significant difference between Humanities and Technical courses in CTD, *p* = .003. Mean score of students in the Humanities was higher than the Technical major students with a mean difference of 6.10 points. However, no significant difference found in IRF across disciplines of study, *F* (2,627) = 2.731, *p* = .066.

Manova resulted in a non-significant differences between year of study; Pillai’s Trace = .011, *F* (4,1254) = 1.665, *p* = .156. Significant differences between reading hours which consist of five groups are tested. Reading hours contributed to a significant difference on both the dependent variables; Pillai’s Trace = .058, *F* (8,1250) = 4.637, *p* = .001. Results of univariate test indicate that there is a significant difference among reading hours on IRF, *F*(4,625) = 4.536, *p* = .001; the highest mean score is 50.05 for > 20 hours of reading per week. Similar results were obtained for CTD; *F*(4,625) = 7.160, *p* = .001with the highest mean of 266.11 for > 20 hours of reading per week. Tukey’s post hoc tests reported significant differences between reading below 5 hours and generally reading for more than 5 hours per week, favouring the latter.

Manova results indicate that parents’ highest qualification has a significant difference on critical thinking; Pillai’s Trace = .047, *F*(8,1250) = 3.800, *p* = .001. Univariate tests resulted in a significant difference between parents’ highest qualification on IRF, *F*(4,625) = 2.036, *p* = .088and CTD, *F*(4,625) = 6.108, *p* = .001.Tukey’s post hoc test showed significant differences between different levels of qualifications. Significant differences were found between primary education and all other higher qualifications, favouring the latter.

Significant differences were found between parents’ annual income; Pillai’s Trace = .045, *F*(8, 1250) = 3.575, *p* = .001.Univariate test indicates that there is a significant difference between parents’ highest qualification on informal reasoning fallacy, *F*(4,625) = 5.142, *p*=.001. Univariate test found significant difference for CTD; *F*(4,625) = 4.207, *p* = .002. Tukey’s post hoc tests reveal that significant differences exist across salary, RM12,000 per annum with salaries ranging from RM24,000 – RM36,000 and > RM48,000, favoring higher salaries.

Statistically significant main effects were obtained for parents’ annual income and parents’ highest qualification. However, it was established that no significant interaction effects between qualification and income level on both the dependent variables, Pillai Trace = .047, *F*(32, 1210) = .901, *p* = .627. Upper class of socio-economic status contributed to significant differences on critical thinking disposition but not informal reasoning fallacy. The lower the socio-economic status, the poorer the student’s critical thinking ability.

**Discussion**

Returning to the research objective posed at the beginning of the study, one of the most significant finding is that a substantial number of students performed moderately in reasoning, which means they managed to moderately evade the given fallacies in the test. This implies that college students are trying their best not to be suppressed by some manipulative tactics, which may be a good start for cultivating this ability further.It is noted that students who are having difficulties in identifying reasoning fallacies pose a threat to themselves and to the proponent of the argument. It simply means that they have deluded themselves from thinking critically.

Consistent with Tarnoff (2010), many individuals have significant difficulties in identifying and rejecting informal fallacies. The finding was in line with findings of Weinstock, Neuman, and Tabak (2004) reported that the ability to identify fallacies at 62%; though only were able to explain these fallacies as much as 38%. This implies by only detecting fallacies is insufficient in order to be critical. These studies supported the notion that college-level students have difficulty in understanding what makes an argument fallacious.

The weakest performance on fallacy is hasty generalization fallacy - downfall of students for not being alert with the limitations to an argument especially in terms of over generalizing a claim based on insufficient samples. Poor performance in hasty generalization fallacy, projects stereotypical nature that is very detrimental for a multiracial country, such as Malaysia. Wrongly generalizing about certain characteristics of a racial or religious group, branding political parties as good or bad, generalizations due to menace triggered from terrorist attacks and other similar conclusions must not be heeded by the society.

Success in the work environment depends closely on consistent internal motivation to think and being able to reason because decision making and problem solving are faced rampantly in the real world. Furthermore, millions of information is being uploaded in the internet every second. Out of them, there are so many debunked information that needs to be filtered for truth. Society clouded with errors in reasoning may be detrimental to the nation as a whole. As cautioned by Paul and Elder (2004), students especially at the tertiary level need to be protective of themselves from becoming intellectual victims.

In the context of CTD, findings suggest that respondents are moderately inclined in being disposed towards critical thinking. Findings are consistent with Krupat et al., (2011) which revealed that absence of critical thinking resulted from heuristic thinking and lack of cognitive effort.

Interestingly, none of the undergraduates are negatively disposed toward critical thinking. The highest inclination is Inquisitiveness - a trait highly expected to be possessed among undergraduates. Being inquisitive indicates that they are curious intellectually and possess the learning desire to seek more knowledge that are not readily available, although for not immediate usage. At the tertiary level, it is anticipated to have high curiosity as the specialized knowledge may seem new to students, leads to probing for in-depth questioning. The multi-disciplinary fields are ever changing with new technologies, new ideas replacing obsolete ones that need some level of inquisitiveness.Many studies support the current finding that Inquisitive disposition was the highest score gained (Facione et al, 1995; Cohen, 2002; Crawford, 2002; Shin et al., 2006; Begbie, 2007; Profetto-McGrath, 2009; Wangensteen et al., 2010).

The most difficult trait to be cultivated is Truth-seeking disposition (Facione, 1990). Truth-seeking disposition being the lowest is consistent with other findings (Facione et al, 1995; Bartlett & Cox, 2000, Crawford, 2002; McBride et al., 2002; Zhao et al., 2007). It is also in accordance with the explanations given by the CCTDI developers that this outcome could be expected among young thinkers. It seems dangerous, as the undergraduates are not keen in seeking to explore inquiries different from their pre-conceived views, ideas or opinions. They are complacent with their own views and refuse to seek the best contextual information by adjusting their beliefs in accordance to those facts and reasons. In other words, they do not ask questions to gain information on relevant details before making a decision or conclusion. In the worst case scenario, deficiency in Truth-seeking equates to possessing biasness, which may impel malpractice in their respective fields because they are inclined to ignore good reasons and relevant evidence so that they do not need to face difficult ideas. Moreover, constant probing in seeking the truth should be cultivated in classroom activities; instead of blindly accepting what is being read and said. In fact, this measure could involve challenging one’s own personal or collective interest and overcoming egocentric values (Jiménez-Aleixandre & Puig, 2012).

Informal reasoning fallacy and critical thinking disposition are significantly correlated and mutually reinforces each other. This finding can fill in the deficit in the body of knowledge. In the context of demographic factors, undergraduates are not disadvantaged over their background variables such as gender, disciplines and year of studies. However, humanities discipline, Diploma programme, longer reading hours per week and higher socio-economic status has contributed tohigher CTD.

Suggestions were proposed that educators should foster development of reasoning skills as part of an academic curriculum. Educationist should lever the cognitive development of students beyond the contents of the course and create environment that foster and encourages critical thinking development. As mentioned by Gelder (2005), deliberate practice in informal reasoning speeds up the power of avoiding fallacious arguments.

Malaysian education system relies heavily on grades rather than grooming attitudes towards thinking critically. The Malaysian Ministry of Education admits that the thinking skills system has been historically fallen short being unable to critically think outside familiar academic context. In the shift 1 of the blueprint, teachers have been focusing on predicting which topics and question will appear in the government examination and then drill to recollect the content. In the new transformation or revamping exercise, students will be trained to think critically and focus on the higher order thinking (Malaysian Education Blueprint, 2012). Hope this strategy will inculcate the habits of thinking from young and will be brought forward into tertiary level of education.

It is a disturbing fact that if performance of this sort continues, Malaysia as a developing country will be lagging behind in the global economy competition. With the demand of the 21st century skills becoming the central issue among universities, Malaysian higher education system needs to embark on enhancing critical thinking among younger generations.

**Conclusion**

This study has explained the central importance of informal reasoning fallacy in critical thinking disposition. It was gathered that moderate performance was discovered in IRF and CTD. There are indications that IRF and CTD are correlated. This signifies that they reciprocally reinforce each other. Undergraduate’s background factors are not a major contributor to IRF and CTD, however some factors do show evidences on the increase in CTD scores, mainly socio-economic status, discipline, programmes and reading hours. Suggestions are made to the tertiary educational provider that they are required to increase theirdetermination in grooming the habit of mind to think critically and to avoid fallacies.

**Acknowledgement**

This paper was supervised by Professor Dr John Arul Phillips, Dean of School of Education and Cognitive Science, Asia e University, Malaysia.

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