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ABSTRACT

This study investigated the perception of university teachers regarding what critical thinking skills are needed for successful undergraduate study, and determined the relative importance of these skills within and across academic disciplines. A total of 3[illegible] university teachers in 6 academic disciplines of Physical Sciences, Biological Sciences, Social Sciences, Humanities, Engineering, and Education in an Australia in university responded to a 72-item questionnaires about their perception of the frequency and importance to success of each item within their academic disciplines. The results showed that academic staff perceive critical thinking skills as having a fundamental role in undergraduate studies and that though a large number of skills are common to all disciplines, some of them are specific to different disciplines. Overall, the skills rated as most important were the abilities to explain ideas with reasonable clarity, to critically reflect on and analyze all information presented, to assemble facts to determine the validity of an argument, and to draw sound inferences from the information formed or given. Common errors cited were a reluctance to be analytical, presentation of a poorly structured argument, and disregarding facts or evidence in drawing conclusions. (JB)

The Role of Critical Thinking Skills in Undergraduate Study as Perceived by University Teachers Across Academic Disciplines

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Abstract

This study investigated the perception of university teachers regarding what critical thinking skills are needed for successful undergraduate study, and determined the relative importance of these skills within and across academic disciplines. A total of 31 university teachers in six academic disciplines of Physical Sciences, Biological Sciences, Social Sciences, Humanities, Engineering, and Education in an Australian university responded to a 72-item questionnaire (with an alpha reliability coefficient of .98), about their perceptions of the frequency and importance to success of each item within their academic disciplines. The results showed that only three and 13 items indicated significant differences ($p < .01$) in perception across academic disciplines with regard to frequency, and their importance to success respectively. The results are discussed and their implications for undergraduate studies highlighted.

Introduction and the problem

The increasing demand being placed on cognitive abilities in education has necessitated focusing on some areas of analytical reasoning as indicators of quality and effectiveness of learning. There is evidence in the literature (Miller & Wild, 1979; Wilson, 1982, Powers and Enright, 1986) to suggest that successful achievement in graduate study has some relationship with analytical reasoning skills. One of such dominating contemporary discourse in higher education is critical thinking. According to Miller and Wild (1979), out of several possible areas of measurement graduate faculty, administrators, and students were most receptive to assessing analytical or abstract reasoning skills.

Critical thinking, is the ability to analyse information, to determine the truth and validity of statements and information, and to translate that information to fill gaps in personal knowledge (McPerk, 1981; Ennis, 1989; Gagne, 1988). Critical thinking has been judged to be desirable quality for students of all ages to acquire (Norris, 1985; Paul, 1985) for a number of reasons. First, the teaching of critical thinking skills is seen as a basic function of education (Allen, 1987) and a medium of equipping students intellectually, emotionally and morally (Paul, 1985). Ausubel (1985) claims that the ultimate objective of schooling should be the development of intellectual skills, and the "ability to think critically, systematically and independently" (p. 71). Second, others see the teaching of critical thinking as the fundamental base necessary for the novice to expert transition (Resnick, 1979; Alexander and Judy, 1988; Eylon and Linn, 1988). Third, it has been found that there is a relationship between effective problem solving and critical thinking skills (Glasser, 1991).

Although a number of studies (see Power and Enright, 1986) has addressed the place of critical thinking skills across and within academic disciplines at graduate level, no concerted effort seemed to have been made to the same at the undergraduate level. And yet the reasons given supporting the need for critical thinking in education cuts across all levels of tertiary education and even primary and secondary at varying degrees. If critical thinking is important for all levels of education, and undergraduate education is seen within tertiary education as laying the foundation for graduate studies, it becomes imperative that attention should also be focused on investigating critical thinking skills necessary for undergraduate work.

The unfortunate neglect of studies in undergraduate thinking skills had meant that undergraduate studies which form the basic foundation of university education and further higher studies do not have any empirically documented information base regarding critical thinking skills as necessary for successful studies within and across academic disciplines. This study has set out as a major objective the investigation of critical thinking skills necessary for undergraduate studies as contribution to the scanty or non-existent literature in this area.

In spite of the fact that there is a global agreement for the need to teach critical thinking in education, and indeed the Seventh international conference was held in 1992 to reinforce the call for doing so (de Bono, 1992; Paul, 1992), there is still no consensus about the place of critical thinking across disciplines. While some hold the view that a solid base of relevant prerequisite knowledge is vital for critical thinking (Mayer, 1975), and that contextual sensitivity is crucial to the development of critical thinking (Norris, 1985), there are those who subscribe to the general nature and transferability of critical thinking skills. In undergraduate studies, do the academic staff see critical thinking skills as specific to their subject discipline areas or do they perceive that they are of general nature? The plethora of research literature on the specific-general debate has not put to rest the controversy. Recently in a study carried out using academic staff of graduate schools as sample, Powers and Enright (1986) reported that some of their subjects made comments such as "the successful problem solving is predicated on having specific knowledge in a field", "the measurement of analytical abilities is quite discipline specific". It does appear therefore that more studies are needed to determine conclusively whether content-specific instructional strategies are better than or preferred to general ones. And specifically for undergraduate studies there is the need to begin discussing this issue from an empirical base.

Purpose of study

While a large number of research investigations have focused on critical thinking skills in graduate studies, and also the content specific-general nature of critical thinking skills in education, few studies have attempted to empirically examine these issues in relation to undergraduate studies. The research reported here specifically addressed the following questions:

(a) what is the perception of university academic staff regarding those critical thinking skills are needed for successful academic achievement at the undergraduate level?

(b) what is the relative importance of critical thinking skills across undergraduate subject area disciplines as perceived by university academic staff?

The Sample

Six academic fields (biological sciences, education, engineering, humanities, physical sciences and social sciences) were included in the study. These fields were chosen because they represent the various fields of undergraduate studies commonly found in most Australian universities and the variation in the types of thinking skills needed for successful undergraduate studies. Using a simple random sampling method, 72 academic staff representing the chosen fields at the University of Queensland were used for the study.

After a series of reminders to the sample by phone and mail, 31 of the academics completed and returned the questionnaire by the close of the six-week deadline given.

Instrumentation

To begin with, 50 senior academic management staff of another university were requested to submit responses to an open-ended questionnaire asking for skills perceived as important for undergraduate entry and exit skills in critical thinking. These senior staff consists of Deans, Associate Deans, Professors, and Heads of Programmes. The academic management staff just like Powers and Enright (1986) did with their sample, were informed of the purpose of the study and requested to give in an open-ended fashion, examples of:

(a) critical thinking skills (pertaining to information seeking analysis of statements, reflective scepticism, induction, deduction, and generation of valid explanations) necessary for successful completion of your faculty's undergraduate award;
(b) the critical incidents, related to these sub-skills, which cause you to raise or lower your estimation of your undergraduate students' critical thinking ability;
(c) particular critical thinking errors observed in those undergraduate students in your care.

A total of 101 thinking skills, incidents and errors was received from the senior academic staff. The items were condensed, added and sorted out into forms and groups. A structured questionnaire was produced to form a combination of the open-ended responses from the senior academic staff, an extensive and comprehensive literature review, and the adaptation of some items from the Powers and Enright (1986) instrument on analytical reasoning skills. The structured questionnaire was subjected to construct validity procedures using a panel of experts in statistics, critical thinking educational and cognitive psychology, and instructional design.

The final version of the structured questionnaire has two major parts: Section A which sought biographical details of the respondents and Section B which contained 72 ideas on critical thinking. Section B contains items relating to critical thinking skills, incidents and errors. Each item has a two-part response for importance to success/hindering success/effect on estimation and frequency. For example, the responses to items was on a five point scale ranging from "critically important difference" to "not relevant to my field" (for importance to success) and "very frequently recurring:" to "Never, or hardly ever" (for frequency of use). See appendix A for details about the instrument.

Data Analysis

The summary statistics of means, standard deviations, minimum and maximum scores were calculated for each question by academic discipline, position and instructional experience.

Analyses of variance (ANOVA) were run for each question to examine the differences among the disciplines, position and instructional experience. In addition, correlation analysis were carried out for the ratings within the two major sub-categories of the critically thinking skills (i.e frequency of use and contribution to success). Factor analyses were also done to effect some réduction in the large number of questions and to see the various statistics they form. A varimax rotation of factors with an eigenvalue of 1.0 and above was used in the factor analyses. This provided an answer to the number of factors to be retained for each of the two major sub-categories.

Results and findings

Tables 1-3 show the mean ratings with significant differences ($p<.05$, $p< .01$) by discipline, position and instructional experience for the items in the instrument. The figures in the 'total' column represent the grand means for all disciplines, positions or instructional experience as may be the case. The numbers under each discipline, position and instructional experience are the deviations from the grand means for each item.

TABLES 1, 2 & 3 ABOUT HERE

A number of significant differences was observed (Tables 1-3) among the disciplines, position and instructional experience with regard to the ratings received from the academic staff. For example with respect to discipline staff ratings indicated significant differences for 'frequency' (3 items), and 'importance to success' (13 items) under critical thinking; for 'frequency' (0 items) and 'significance in hindering success' (3 items) under critical thinking errors; and for 'frequency' (0 items) and 'effort on estimation' (2 items) under critical thinking incidents (see table 4). The highest number of items with significantly different ratings were recorded for 'importance to success' (39%) and 'frequency' (45%) with regard to discipline and position of the academic staff respectively.

TABLE 5 ABOUT HERE

The ANOVA for all 'frequency' items, 'success' items (Table 5) indicated that no significant differences ($p<.01$) were found for the ratings given to the items pooled together when considered with respect to the moderator variables.

TABLES 6& 7 ABOUT HERE

Tables 6, 7, 8 & 9 contain the skills, errors and incidents respectively that were judged as relatively important, and for which average ratings did not show any significant differences across disciplines, positions and instructional experiences. The tables show only those skills, errors and incidents that received average ratings of importance of more than 4.0 over all and for which analyses of variance did not indicate any significant differences.

TABLES 8 &9 ABOUT HERE

Validity and Reliability

With regard to correlations between "frequency of use" and "importance for success" the Pearson correlation coefficients obtained for skills, errors and incidents were .85, .51 and .36 respectively. The correlations between the skills and errors are significant at $p < .01$. The inter-scale correlations for "frequency of use" sub-scales ranged between .56 and .79 while those relating to the "importance to success" sub-scales (skill, error and incidence) ranged between .34 and .76. They all indicated high association between sub-scales ($p<.05$).

The Cronbach alpha reliability coefficient for the whole instrument was .98. This and the series of inter-scale correlation coefficients indicated the very high internal consistency of the instrument. The construct validity of the instrument was determined by a panel of ten academic staff, 5 distance educators and three research methodologists. 15 items were dropped at this stage, while several others were reconstructed or reallocated to subscales as suggested by the panel.

In order to identify any trend of groupings of the items in the instrument, factor analyses were computed for the two areas of "frequency of use" and "importance to success". The factors which emerged from these statistical analyses were viewed only as a reflection of the dimensions that underline university academic staff's perception of critical thinking. They are therefore not necessarily completely representative of dimensions of critical thinking. The results of the factor analyses therefore present a parsimonious representation of academic staff perceptions rather than a basis for postulating distinct critical thinking facilities (Powers & Enright, 1986).

The varimax rotation according to Kaiser criterion (Kaiser, 1958) performed on the 'frequency of use' turns, extracted 7 factors with eigenvalue of more than 1.0. These seven factors have eigenvalues of 26.6, 10.1, 4.8, 4.3, 3.7, 3.2, and 3.2. The application of the Scree test (Cattell, 1966) which plots the total variance associated with each factor indicates that a three-factor model for the "Frequency of Use" items should be sufficient.

Factor I accounted for about one third (35.7%) of the common variance and has the highest loadings mostly from the area of skills. It appears therefore that factor I overlaps to the skills aspect of critical thinking. Factor II accounted for 14% of the common variance and relates the error aspects of critical thinking. Factors II-VII each has less than 7% of the common variance but together add up to 27%. The way the items load on the factors suggest that they point to incidents and hence would be emerged into a factor.

The factor analysis on items that reflect 'importance to success' loaded on 17 factors with eigenvalue of 1.0. These 17 factors make up 96.6% of the common variance. The application of the scree test indicated that, similar to what occurred with the 'frequency of use' items, the items under 'importance to success' could be appropriately grouped into three factors.

Factor I accounted for about 27.4% (eigenvalue 19.7) of the common variance and has the highest loadings mostly from the area of skills. Factor I would appear to relate to success of the skill aspects of critical thinking. Factor II takes about 10.3% of the common variance and made up mainly of years which relate to errors. Factors II-XVII has a total of 58.8% of the variance with each having an eigenvalue ranging between 1.06 and 6.01. The loading of the items on these factors indicate that they could be pooled into one common factor as most of the items relate to incidents.

The results of the factor analyses are therefore supportive of the grouping of the reasoning skills into the three areas of critical thinking skills, critical thinking errors and critical thinking incidents.

Discussion and Implications

A major focus of the study is the investigation of the perception of university teachers regarding what critical skills are needed for successful academic achievement at the undergraduate level. The second focus was the determination of the relative importance of these skills across disciplines and in relation to the position and instructional experience of the academic staff.

As a vehicle for reaching the above goals an instrument was designed to probe the perceptions of academic staff of the target university and to obtain the necessary data. The 72-item instrument which was modelled after that of Powers & Enright (1986), was validated, has a high reliability coefficient (.98) and was factor analysed to expose clusters of items. The clusters of skills extracted are three: 'frequency of use'; 'importance for success'; and 'critical errors and incidents'.

The clusters of critical thinking items extracted in this study by principal factoring with varimax rotation agrees largely with those reported in the literature e.g., Powers and Enright (1986),

Ward, Carlson, and Woisehschlager (1983). A new perspective added by the present study is the development of an instrument for the assessment of analytical reasoning skills at the undergraduate level. Hither to what appeared to be prevalent and of priority concern was the assessment of thinking skills at the graduate school level (Miller & Wild, 1979; Wilson 1982; Powers & Enright, 1986). There is now therefore a valid and reliable instrument that could be used to assess the critical thinking skills, errors and incidents across undergraduate discipline study areas.

Attention should be focused next on what critical thinking skills academic perceived as necessary for successful academic achievement at the undergraduate level. The results as shown in Tables 6-9 indicate that irrespective of discipline areas undergraduate learners require a set of critical thinking skills to be frequently used in their studies. Table 7 confirms the critical skills rated as moderately important to success while Tables 8 and 9 contain critical thinking errors hindering academic success; and those having moderately significant effect on estimation of the manly focal ability of students.

The information in Tables 6, 7, 8 & 9 show that the critical thinking skills errors and incidents rated as most important overall and common for all undergraduate studies are:

Skills

explain ideas with reasonable clarity
critically reflect on and analyse all information presented
assemble facts to determine the validity of an argument
draw sound inferences from the information formed or given

Errors

be reluctant to be analytical
present a poorly structured argument
disregard facts or evidence in drawing conclusions

Incidents

submit a paper that failed to address the assigned tasks
present an alternative, original hypothesis or explanation

A brief comparison by these with the results obtained by Powers and Enright (1986) with postgraduate studies indicate that two critical thinking skills (draw sound inferences from the information formed or given, and the incident of submitting a paper that failed to address the assigned tasks) have similar high rating by the American and Australian academic staff. One

possible explanation for the absence of many skills of similar rating between undergraduate and graduate studies must be related to the scope, depth and novelty of ideas and skills that need to be demonstrated at the graduate level over and above undergraduate studies. Two trends found in the present studies were also found by Powers and Enright (1986). They are that (i) some skills were viewed as extremely important in all disciplines; and (ii) academic staff are generally able to discriminate among the various skills, errors and incidents they were requested to consider (see Table 4) even though as shown in Table 6 & 7 a sizeable proportion was rated to be at least moderately important on average. One interesting result worth noting is that the analyses of variance to compare the mean differences among the various levels of the moderator variables on their perceptions of critical thinking skills group I and II did not indicate any significance ($p<.05$) as shown in Table 5.

With regard to the determination of the relative importance of the critical thinking skills as perceived by the academic staff, there is a strong indication as shown in Tables 1-3 that academic staff perceptions were reflected by their discipline, position and instructional experience. However, it would be noted that the number of skills affected in this manner is very few. The perception of the frequency of use and the 'importance of success' of the critical thinking skills seem to be the areas most affected by the variables of discipline, position and instructional experience (Table 4). On the other hand, position of academic staff account for about 45% of the skills identified as requiring frequency of use, about 39% of the skills perceived as important to success was accounted for by the discipline of the academic staff.

In summary, this study has shown that academic staff perceive critical thinking skills as having a fundamental role in undergraduate studies. It has also indicated that whereas a large number of skills are common to all disciplines, some of them are specific to different disciplines. The moderator variables of discipline, position and instructional experience of academic staff have a varying relationship with their perception of the role of critical thinking skills in undergraduate studies. Last but not the least an instrument has emerged for use in determining perception about critical thinking skills in undergraduate studies. Its use in this study has also revealed that there are differences between the skills required for undergraduate and graduate studies.

In investigating the perceptions of academic staff on the involvement of different critical thinking skills in their disciplines, this study has a number of implications. First, is the need to replicate this study with specific attention to further validation of the instrument in other environments, countries, disciplines and learning modes. The fact that it has shown distinction that critical thinking skills needed for undergraduate studies are different from those of graduate studies lead to the need to (a) focus on the development of critical thinking skills at the undergraduate level for successful academic achievement, and (b) relating the development of critical thinking skills for undergraduate and graduate studies in such a way that there is a logical progression from one to the other and for the undergraduate ones to serve as the necessary base for graduate skills.

Second, the study has shown that academics identify, and discriminate among, the various skills, errors, and incidents they perceived as affecting undergraduate studies. Identifying them is one thing but translating them operationally within instructional setting is another. It would therefore be necessary for further studies to be undertaken to ascertain if academic programmes at undergraduate levels actually teach the skills identified in this study.

Finally, the results of this study indicated that some critical thinking skills are viewed as more important for success in some discipline than in others (see Tables 1-3). What seems to be implicated here is the old argument of whether particular critical thinking skills are needed for particular academic disciplines, and if critical thinking skills are subject matter knowledge specific. Further verification of this will be illuminative for contemporary educational endeavours.

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Table 1: Mean Ratings of the Importance of Critical Thinking Development by Undergraduates, According to Academics, by Discipline (Significant Items Only).

VARIABLES	TOTAL (N=31)	DISCIPLINE: PHYSICAL SCIENCES	BIOLOGICAL SCIENCES	SOCIAL SCIENCES	HUMANITIES	ENGINEERING	EDUCATION	F
Skills (Frequency)								
12. Make explicit the most relevant components in a chain of logical reasoning.	3.60	.10	-.07	1.10	-1.20	-1.40	.17	2.62 *
20. Test the validity of an argument by searching for counter-arguments.	3.70	.20	.03	-.13	-1.30	2.70	.56	3.92 **
21. Detect logical fallacies in statements.	3.31	.31	-.36	1.11	-1.29	2.31	.17	2.99 *
(Importance to Success)								
1. Assemble facts to determine the validity of an argument	4.52	-.48	.07	.37	-.48	-.48	.09	3.08 *
10. Generate alternative models and hypotheses.	3.77	1.27	-.56	-.08	-.43	2.77	.35	2.60 *
11. Analyse knowledge within a given domain and context.	4.17	.17	.06	1.00	-.63	.17	-.40	3.45 *
12. Make explicit the most relevant components in a chain of logical reasoning.	4.03	.53	.03	.83	-.97	-.97	.03	3.34 *
13. Distinguish between relevant and irrelevant information.	4.42	-.08	-.03	.56	-.58	2.42	-.44	6.59 **
14. Draw distinctions between similar but not identical ideas.	3.73	1.23	-.04	-.60	-.87	1.73	.59	3.97 **
15. Use a framework based on knowledge to critically evaluate the worth of methods, aims and content.	3.81	.81	-.75	.38	-.39	2.81	.24	3.35 *
18. Differentiate the shades of meaning in a statement	3.53	1.03	.20	.37	-1.27	2.53	-.32	3.06 *
20. Test the validity of an argument by searching for counter-arguments.	3.80	.30	.36	-.37	-1.00	2.80	.09	3.03 *
21. Detect logical fallacies in statements.	3.86	-.64	-.14	.86	-.74	2.86	-.14	2.82 *
22. Evaluate and make judgements concerning arguments.	4.03	.53	.26	.03	-.97	3.03	-.25	3.80 *
25. Construct, in written form, a sustained argument.	4.23	.73	-.43	1.07	-.77	.23	-.05	2.91 *
27. Explain ideas with reasonable clarity.	4.58	.58	.14	.29	-.42	-.42	-.28	3.37 *
Errors (Significance in Hindering Success)								
4. Poorly source an argument or statement.	3.70	.70	.03	.84	-.70	-1.30	-.30	2.72 *
6. Do not relate external causes to internal events.	3.33	-.67	.17	1.17	-.87	-1.67	.17	3.53 *
12. Offer irrelevant evidence to support a point.	3.77	-.23	.88	.05	-1.03	-.23	-.38	2.68 *
Incidents (Effect on Estimation)								
1. Be content not to scrutinise others! and own biases, and therefore present biased work.	3.74	1.24	-.15	.17	-1.26	1.74	.31	3.05 *
3. Submit a paper that failed to address the assigned tasks.	4.20	1.20	-.30	-.23	-.60	2.20	.34	3.57 *

$p < .05$ * $p < .01$ **

Table 2: Mean Ratings of the Importance of Critical Thinking Development by Undergraduates, According to Academics, by Position (Significant Items Only).

VARIABLES		POSITION						
		TOTAL (N=31)	TUTOR	LECTURER	SENIOR LECTURER	ASSOC. PROF./ READER	PROFESSOR	F
Skills (Frequency)								
5.	Incorporate isolated instances or data into a pre-existing framework.	3.43	.83	-.15	-.34	-.57	2.43	2.17 *
9.	Identify the most significant variables involved in a problem.	4.07	1.27	-.27	-.16	-.27	-.93	3.60 *
10.	Generate alternative models and hypotheses.	3.55	1.75	-.20	-.67	-.70	2.55	6.27 **
12.	Make explicit the most relevant components in a chain of logical reasoning.	3.60	1.20	.18	-.40	-1.07	-1.40	2.75 *
13.	Distinguish between relevant and irrelevant information.	4.23	.43	.23	-.44	-.77	2.23	3.03 *
15.	Use a framework based on knowledge to critically evaluate the worth of methods, aims and content.	368	.28	.18	-.88	.43	2.68	3.06 *
20.	Test the validity of an argument by searching for counter-arguments.	3.70	-.10	.37	-.52	-.63	2.70	2.85 *
21.	Detect logical fallacies in statements.	3.31	.71	.49	-.80	-1.36	2.31	4.04 **
22.	Evaluate and make judgements concerning arguments.	3.93	.33	.35	-.73	-.73	2.93	3.71 *
23.	Evaluate the strengths of various types of evidence (correlation,causation, testimony).	3.48	.88	.23	-.85	-.52	2.48	2.74 *
25.	Construct, in written form, a sustained argument.	3.97	.17	.80	-.70	-1.03	-1.03	3.18 *
26.	Determine whether the conclusions drawn are logically consistent with, and adequately supported by, data or accepted information.	4.29	1.09	.21	-.49	-.71	-.71	4.18 **
28.	Detect statements where the conclusion does not follow.	3.53	1.13	.28	-.80	-1.47	2.53	4.59 **
30.	Classify according to various attributes.	3.13	1.33	-.03	-.20	-.87	-1.87	2.72 *
32.	Compare newly developed conclusions with what is already known.	3.74	1.14	.16	-.48	-.51	-1.26	3.06 *
	(Importance to success)							
5.	Incorporate isolated instances or data into a pre existing framework.	3.43	.43	-.23	.10	-.90	2.43	2.69 *
10.	Generate alternative models and hypotheses.	3.77	.97	-.06	-.45	-.73	2.77	3.67 *
13.	Distinguish between relevant and irrelevant information.	4.42	-.18	.25	-.25	-.58	2.42	5.19 **
15.	Use a framework based on knowledge to critically evaluate the worth of methods, aims and content.	3.81	.01	.06	-.75	.81	2.81	4.00 **
20.	Test the validity of an argument by searching for counter-arguments.	3.80	-.80	.38	-.20	-.53	2.80	3.53 *
22.	Evaluate and make judgements concerning arguments.	4.03	-.17	.20	-.30	-.63	3.03	3.50 *
28.	Detect statements where the conclusion does not follow.	3.80	.40	.05	-.20	-1.20	2.80	3.28 *
Errors (Hindrance to Success)								
17.	Subjectively arrive at conclusions without logic.	3.93	-.27	-.25	-.07	.60	2.93	2.80 *
Incidents (Frequency)								
19.	Present an alternative, original hypothesis or explanation.	2.07	.87	-.10	-.04	-1.27	1.07	3.41 *
	(Effect on Estimation)							
7.	Have a genuine enthusiasm for learning.	4.00	.00	-.64	1.11	-.50	-1.00	3.61 *
10.	Present a valid justification of personal views.	3.42	.22	-.50	.75	-.58	.42	2.69 *

$p<.05$ * $p<.01$ **

Table 3: Mean Ratings of the Importance of Critical Thinking Development by Undergraduates, According to Academics, by Instructional Experience (Significant Items Only)

VARIABLES		TOTAL (N=31)	INSTRUCTIONAL EXPERIENCE: 0 to 5 YEARS	6 to 10 YEARS	11 to 15 YEARS	16 to 20 YEARS	OVER 20 YEARS	F
Skills (Frequency)								
12.	Make explicit the most relevant components in a chain of logical reasoning.	3.60	1.10	-1.00	-.40	.42	-.90	4.35 **
	(Importance to Success)							
12.	Make explicit the most relevant components in a chain of logical reasoning.	4.03	.70	-.97	.03	.22	-.47	3.52 *
Errors (Frequency)								
15.	Disregard facts or evidence in drawing conclusions.	3.10	1.27	.30	1.10	-.71	-.70	4.11 *
	(Significance in Hindering Success)							
5.	Ineptly draw out conclusions from repeated examples.	3.96	.46	-.44	-1.04	.46	-.64	5.86 **
11.	Resist the learning of terminology.	3.67	-.50	-.90	.67	.85	-.50	4.12 **
Incidents (Frequency)								
19.	Present an alternative, original hypothesis or explanation.	2.07	.73	.47	.57	-.57	-.27	2.96 *
	(Effect on Estimation)							
3.	Submit a paper that failed to address the assigned tasks.	4.20	-.63	-.40	-.80	.10	.91	3.99 **
14.	Accept and hold a 'closed', tidy picture of reality.	3.27	-.23	-.93	-1.73	.45	.77	3.07 *

$p<.05$ * $p<.01$ **

Table 4: Summary of the total number of critical thinking items in each sub-scale showing significant differences by discipline, position and instructional experience.

	Skills		Errors		Incidents	
	frequenc y	Importance to success	frequency	significance in hindering success	frequency	Effect on estimation
Discipline	3 (33)	13 (33)	0 (19)	3 (19)	0 (20)	2 (20)
Position	15 (33)	7 (33)	0 (19)	1 (19)	1 (20)	2 (20)
Instructional Experience	1 (33)	1 (33)	1 (19)	2 (19)	1 (20)	2 (20)

* figures in parenthesis indicate the total number of items in each subscale.

Table 5: Summary of ANOVA between critical thinking skills group I (frequency) and group II (success) by some moderating variables.

	Frequency			Success		
Moderator variables	**DF**	**MS**	**F. Ratio**	**Df**	**Ms**	**F-Ratio**
Discipline	4	4423.6	2.32	4	2511.1	2.75
Gender	1	235.2	.09	1	155.5	.12
Years of instructional Experience	3	4941.1	2.52	3	1799.8	1.58
Academic Position	3	2707.6	1.16	3	1483.4	1.24
Highest qualification	2	2433.5	1.02	2	611.7	.47
Year highest qualification was obtained	3	5859.7	3.08	3	606.9	.46

* significant at $p < .01$

Table 6: Critical thinking skills rated by academic staff irrespective of discipline, position and instructional experience as at least frequently used by undergraduates.

Variables	Mean Rating
Assemble facts to determine the validity of an argument	4.32
Generate solutions to problems	4.12
Determine associations between similar ideas, objects and situations	4.27
Critically reflect on and analyse all information presented	4.48
Relate what kind of evidence will support a thesis or hypothesis	4.17
Clearly identify central issues and problems to be investigated or hypothesis to be tested	4.26
Identify the most significant variables involved in a problem	4.07
Analyse knowledge within a given domain and context	4.17
Distinguish between relevant and irrelevant information	4.23
Draw sound inferences from the information found or given	4.40
Produce an argument that is internally consistent	4.27
Determine whether the conclusions drawn are logically consistent with, and adequately supported by, data or accepted information	4.29
Explain ideas with reasonable clarity	4.61
Generate valid explanations to account for information	4.00
Be willing to evaluate an argument or proposition posed by an authority	4.03

Frequently used is defined as having an average rating over all of 4.00 or greater. There were no significant differences ($p<.05$) with respect to the frequency of use by discipline, position and instructional experience.

Table 7: Critical thinking skills rated consistently by lecturers irrespective of disciplines, position and instructional experience, as at least moderately important to success.

Variables	Mean Rating
Assemble facts to determine the validity of an argument	4.52
Generate solutions to problems	4.23
Determine associations between similar ideas, objects and situations	4.07
Critically reflect on and analyse all information presented	4.61
Relate what kind of evidence will support a thesis or hypothesis	4.23
Clearly identify central issues and problems to be investigated or hypothesis to be tested	4.40
Identify the most significant variables involved in a problem	4.23
Analyse knowledge within a given domain and context	4.17
Distinguish between relevant and irrelevant information	4.42
Draw sound inferences from the information found or given	4.60
Produce an argument that is internally consistent	4.30
Determine whether the conclusions drawn are logically consistent with, and adequately supported by, data or accepted information	4.42
Explain ideas with reasonable clarity	4.58
Be willing to evaluate an argument or proposition posed by an authority	4.17
Revise a previously held view to account for new information	4.06

Importance to success is defined as having an average rating over all of 4.0 or greater. There were no signifncant differences ($p < .05$) with respect to the frequency of use by discipline, postion ansd instructional experience.

Table 8: Critical thinking errors rated by lecturers irrespective of disciplines, position and instructional experience as at least moderately significant in hindering success.

Variables	Mean Rating
Present a poorly structured argument	4.47
Be unable to follow an argument	4.37
Fail to select important features on complex information	4.20
Fail to read information and instructions correctly	4.10
Be reluctant to be analytical	4.50
Make generalisations on the basis of insufficient evidence	4.25
Disregard facts or evidence in drawing conclusions	4.41

Moderately significant is defined as having an average rating over all of 4.0 or greater. There were no signifncant differences ($p < .05$) with respect to the frequency of use by discipline, postion ansd instructional experience.

Table 9: Critical thinking incidents rated by lecturers irrespective of disciplines, position and instructional experience as at least having moderately significant effect on estimation of the analytical ability of students.

Variables	Mean Rating
Submit a paper that failed to address the assigned tasks	4.20
Have a genuine enthusiasm for learning	4.00
Present an alternative, original hypothesis or explanation	4.07
Ignore details that contradict an expected or desired result	4.00

Moderately significant is defined as having an average rating over all of 4.0 or greater. There were no signifncant differences ($p < .05$) with respect to the frequency of use by discipline, postion ansd instructional experience.