Critical Thinking Skills among Final Year Students of Malaysian Technical Universities

Aziz Yahya*, Safiah Sidek and Zanariah Jano
Centre for Languages and Human Development,
Universiti Teknikal Malaysia Melaka (UTeM)

*Corresponding email: aziz@utem.edu.my

Abstract

Critical thinking is an essential skill that individuals need to have in order to be effective learners and workers in the global knowledge economy. In line with the mandate of the Ministry of Higher Education Malaysia (MOHE), institutions of higher learning including universities under the Malaysian Technical Universities Network (MTUN) have adopted several approaches to ensure that their graduates are equipped with the sufficient level of critical thinking skills. However, there is little knowledge about the attainment levels of critical thinking skills, among Malaysian tertiary students. Thus, the California Critical Thinking Skill Test (CCTST) was used to collect data from one hundred final year students at four Malaysian Technical Universities in order to identify their attainment level on critical thinking skills. The CCTST scores revealed that these students exhibit some proficiency in critical thinking, but they are way behind the global standard, as stipulated by Insight Assessment California. Students' competencies of the CTS also vary across the four universities. This study has significant implications on the curriculum design and development as well as pedagogical practice adopted by MTUN universities in developing their students with appropriate level of critical thinking skills.

Keywords: assessment, California Critical Thinking Skill Test (CCTST), critical thinking, curriculum development

---

This research was made possible by the funding from the Universiti Teknikal Malaysia Melaka under PJP/2009/PBPI (12G)-S596.

1. INTRODUCTION

Critical thinking is an essential skill that individuals need to have in order to be effective learners and workers as well as good citizens. To be effective learners and responsible citizens in an increasingly complex society surrounded with abundance source of information, individuals are expected to be able to handle vast amount of information and make thoughtful decision [2]. Further, the development of a workforce with advanced technical skills coupled with well developed generic skills, such as creative thinking, problem solving and analytical skills are greatly needed in industries and countries operating in the global knowledge economy. Hence, the development of students' critical thinking is regarded by educators, employers, and policy-makers as a crucial educational priority. However, the issue is to what extent students have acquired the critical thinking skills.

The lack of critical thinking skills among fresh graduates who have just entered the workforce has been one of the main concerns of employers. Based on a study conducted by Nurita, Sharudin and Ainon [3], it was found that Malaysian employers generally agreed that Malaysian graduates are well trained in their areas of specialization, but they lack transferrable skills or soft skills, such as communication skills, problem solving skills, interpersonal skills and the ability to be flexible. Furthermore, based on the study carried out by Azami et. al. [4] critical thinking skills (CTS) has been identified as one of the top three skills that the employers expect from the engineering graduates students. Despite the documented importance of having CTS, there is limited research that measures the attainment level of these skills, particularly in Malaysia. Additionally, several researchers have noted that measures of assessment have not been consistent [5, 6].

Teaching students how to think critically has become a global concern in higher education. In Malaysia, the Ministry of Higher Education (MOHE) has listed CTS as one of the seven skills that students need to develop during their tertiary education[7][1]. As mandated by MOHE, the integration of CTS in the Malaysian higher education has been implemented since 2008. Hence, it is timely to measure students' attainment level of CTS in order to investigate the effective implementation of this policy.

In view of CTS as one of the important employability skills for graduates, it is appropriate to test the level at which the final year students possess such skills. This paper reports a study that investigated the attainment levels of critical thinking skills among final year engineering students across four universities of the Malaysian Technical Universities Network (MTUN). Considering the global concerns on the development of CTS, the study utilized an internationally recognized test, namely the Critical Thinking Skills Test (CCTST) to assess students' CTS. Specifically, this paper aims to address the following research questions:

1) What is the overall attainment level of CTS of the final year engineering students in relation to global standard stipulated by Online Assessment California?
2) What are the attainment levels of the five CTS sub-skills, namely the analytical, evaluation, inference, deductive and inductive reasoning skills among students across the four universities?
3) What are the differences of the students' attainment level of CTS across the four universities?

2. LITERATURE REVIEW

2.1 The Critical Thinking Skills

While most educators and researchers generally agree that critical thinking is a desired outcome for students, there appears to be a lack of consensus regarding the operational definition of critical thinking [6,8]. Among the most useful definitions is the one provided by Scriven and Paul [9], in which they asserted that "critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action". Highlighting on individual's disposition, Ennis [10] suggested that critical thinking is the results of interaction of a set of dispositive thinking: seeking a clear statement of the questions, seeking reasons, trying to be well-informed, and trying to remain relevant the main point. Based on their analysis of the different definitions of CTS, Fischer and Spiker [11] assert that most definitions for the term "critical thinking" include reasoning/logic, judgment, meta-cognition, reflection, questioning, and mental processes.

Due to the different descriptions of critical thinking, this study uses the definition offered by American Psychology Association (APA) Delphi Report (1990)[12]. Focusing on describing the characteristics of an ideal thinker, the Delphi report states 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,

[1] MOHE has identified seven generic skills that students need to develop which are the communication, critical and problem solving, life-long learning and information management, team work, entrepreneurship, professional ethics and leadership skills.

> 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 [12].

The report also described critical thinking "as the process of purposeful, self-regulatory judgment. This process gives reasoned, consideration to evidence, context, conceptualization, methods and criteria" [13]. In this regards, critical thinking is categorized into cognitive abilities and affective disposition [12].

This paper posits that CTS is not a naturally developed skill. Instead, it is a skill which can be taught either directly or implicitly, and should be taught in a gradual development process of learning. The aim of teaching CTS in higher education is to enhance students' thinking skills and thus better prepare them to function productively in the global knowledge economy. Indeed, CTS is essential for good and apt decision making and for the understanding of problematic issues.

A widely used framework for developing CTS is the cognitive domain of Bloom's taxonomy (Bloom et al, 1956). The framework consists of six types of cognitive operations, namely the knowledge, comprehension, application, analysis, synthesis and evaluation. The ability to develop CTS may be likened to Piaget's concrete and formal operations since stages of cognitive development are linked to intellectual potential and environmental experiences [14]. When students have not reached the formal operations stage, their ability to use critical thinking skills is likely to be limited by an inability to handle abstract ideas.

2.2 CTS in Malaysian Higher Education

In Malaysia, several researchers [4,15] in engineering education have identified CTS as one of the important employability skills for graduate engineers. It is considered especially important for engineering professionals who are expected to make important decisions, solve technical problems, face ethical balances, employ best practices, and report and document their findings and products, as well as act in a consultant capacity. In a study on employers' expectation on employability skills, among graduate engineers, Azami et. al [4] highlighted the need for engineering programs to improve in the non-technical aspects and CTS has been identified as one of the important employability skills. They also developed employability skills framework expected by employers and listed thirteen most important soft skills. This framework is based on the professional skills identified in the Accreditation of Engineering Programs (EAC) and "The Future of Engineering Education in Malaysia 2007" [15]. With respect to CTS, engineering students are expected to be equipped with the ability to undertake problem identification, apply problem solving, formulation and solutions [4] .

The integration of soft skills in Malaysian higher education is based on two models: the stand alone subject model and the embedded model [7]. The stand alone subject model uses the approach of training and provides opportunities to students to develop critical thinking and problem-solving skills through specific courses which cater for that purpose.

The development of CTS as outlined by MOHE, is based on two main types of skills; the "must have" and the "good to have" skills [7]. The 'must have' skills must be acquired by each and every student in the institutions of higher learning without which, the student is regarded as incompetent in the above skill. The need to have soft skills can be regarded as the additional generic skills and a bonus to the students. Table 1 gives a detail description of the category of implementation for critical thinking and problem solving skills.

Table 1: The Framework of CTS in Malaysian Higher Education

Category	Abilities
Must have Skills	• To identify and analyze problems in difficult situation and make justifiable evaluation; • To expand and improve thinking skills, such as explanation, analysis and evaluation discussion; • To find ideas and look for alternative solutions
Good to have Skills	• To think outside the box • To make conclusion based on valid evidences • To withstand and give full attention to the responsibilities given • To understand and accommodate oneself to the new working culture and environment

Although MOHE has provided the framework to integrate the soft skills that students need to develop during their course of study at the university, universities have been given flexibility to implement the integration of soft skills in their curriculum.

3. METHODS

3.1 Design

This study used a global commercial test developed in a project led by Facione [16] for the American Philosophical Association, namely the CCTST. This test provides an objective measure of CTS based on five sub-skills which are analysis, evaluation, inference, deductive reasoning and inductive reasoning. The descriptions of the five sub-skills as defined by the CCTST test are provided in Table 2 below. The total scores and the individual scores of the five sub-skills were used to measure the achievement level of CTS among students who are undergoing the Malaysian engineering education system.

Table 2: The Five sub-skills of CTS evaluated in CCTST

Aspects	Descriptions/definitions
Analysis	To examine multiple data sets To identify the intended and actual inferential relationships with the ability to express belief, judgment, experience, reasons information or opinion To examine ideas, detect arguments, and analyze arguments
Evaluation	To examine context, criteria, and evidence in justifying results; To look at a situation in its entirety before drawing conclusions To access the logical strength of the actual or intended inferential relationships
Inference	To draw conclusions or create hypotheses from data To identify and secure elements needed to draw reasonable conclusions To list querying evidences, form conjectures and draw conclusions To consider relevant information and elicit consequences flowing from the data, with the ability to query evidence, conjecture alternative, and draw conclusions
Explanation /Reasoning (Inductive and deductive)	To present in a cogent and coherent way the results of one's reasoning To state and justify the reasoning To describe methods and results, justify procedures, proposing and defending with good reasons, To present full and well reasoned arguments in seeking the best understandings possible.

Source: The CCTS Test – Form 2000

3.2 Instrumentation: California Critical Thinking Skills Test (CCTST)

The self-administered CCTST test was chosen to collect the data due to its efficiency and economical characteristics. The CCTST contains 34 multiple-choice questions of varying levels of difficulties ranging from A to E. It comprised of five sub-scale scores. As shown in Table 3, the possible total scores ranges from 0 to 34. All the questions are text-based and measures CTS in more general authentic problem situations because it contains questions that focus on situations not concerning any particular a course but, rather, everyday situations.

Table 3: Range of Possible Scores according to Subscales

Total and Subscales	Range of Possible Scores
Analysis	0-7
Evaluation	0-11
Inference	0-16
Deductive Reasoning	0-17
Inductive Reasoning	0-17
Total Score	**0-34**

Validation studies of the CCTST Form 2000 produced internal consistency estimates of Kuder-Richardson 20 equal to 0.80 and 0.78[17], the CCTST is claimed to be sensitive to the educational effects of coursework designed to enhance the CTS [18]. Furthermore, having been developed as conceptually consistent with the Delphi expert consensus definition, the CCTST is assumed to have both content and construct validity.

3.3 Setting and Sample

The study was conducted at four focus universities, under the Malaysian Technical Universities Network (MTUN). These universities are among the newly established universities that offer technical education system in Malaysia. For the purpose of confidentially, the identity of the universities is represented by University A, B, C and D.

An equal number of students (25 students) from each of the universities responded to the test. As future engineers, they have enrolled in courses which put emphasis on the development of CTS. Hence, it is assumed that these samples represent those who have formal exposure and training in developing CTS through the Malaysian engineering education. However, the integration of CTS in the university's curriculum and teaching approaches varies across the four universities.

3.4 Procedures and Data Analysis

The test was administered during the prescribed 50 minute period of time in the class under the supervision of the researchers. During the test, participants were first briefed on the expected tasks. They were also asked to read and provide their personal information in the score sheet. Participants were given approximately 50 minutes to choose the answer from multiple choices. Upon completion, the participants were instructed to return the score sheet and test booklets to the researchers. The completion rate was 100 percent.

The score sheets were sent to the Insight Assessment, California for data analysis. The results, presented in descriptive statistical analysis, were mailed to the researchers.

4. RESULTS

4.1 The overall CCTST total scores of the final year engineering students across the four universities

The overall result of CCTST (See Table 4) showed that the total scores ranged with a minimum of 3.00 and a maximum of 20.00. The results showed that 58 out of the 100 final year engineering students had a total scores ranged from 3.00 to 11.00. These results indicate that there are serious deficiencies in CTS among this group of students. The other 42 students were within the satisfactory range and associated with demonstrated competence of CTS in most situations.

The mean total scores of the Malaysian respondents were compared with the mean total scores of the Insight Assessment sample group, that is the fourth-year California college students. The results revealed that the mean total scores of the final-year engineering students (11.18) were lower than the fourth-year California college students (18.00). As a group, the Malaysian final year engineering students did not have the satisfactory global standard of the CTS. However, it was not possible to perform analysis between the final-year engineering students mean scores and those of the fourth-year college students due to the Insight Assessment sample supplying only aggregate data.

Table 4: Descriptive Statistics of overall CCTST Total Scores of the final-year Engineering Students across Four Universities

Stat Analys	Uni A *(N=25)*	Uni B *(N=25)*	Uni C *(N=25)*	Uni D *(N=25)*	**Total *(N=100)***
Mean	12.96	8.00	11.24	12.52	**11.18**
Median	12.00	8.00	11.00	12.00	**11.00**
SD*	3.057	2.78	3.908	3.417	**3.81**
Min	8.00	3.00	3.00	7.00	**3.00**
Max	20.00	17.00	18.00	20.00	**20.00**

SD indicates standard deviation

Based on the analysis of the total scores across the four universities, students from University A have the highest mean score (M=12.96) followed by students from university D (M=12.52), and university C (M=11.24). Students from University B have the lowest mean score (M=8.00). The different total scores can be implied that different universities adopted different ways in integrating CTS in their curriculum and teaching approaches. Furthermore, considering that University B has the lowest mean (M=8.00) in comparison to the other three universities, it is interesting to explore the approaches and strategies used by University B in developing CTS among their students.

4.2 Students' achievement of the CTS sub-skills

The results of the final-year engineering students' scores for the each of the five sub-skills are shown in Table 5. Since the sub-scores of each of the skills are not equally distributed, it is not possible to make a comparison between the sub-skills based on the mean and standard deviation. However, based on Table 5, the students' mean scores for each of the five sub-skills were considerably low. In fact, there were instances where students were not able to get any points, particularly in the analysis and interpretation skills and the evaluation skills.

Table 5: Descriptive Statistics of overall CCTST sub-scores of the final year engineering students

Sub-Skills	Mean	Median	Min	Max	SD*
Analysis & interpretation (S*=7)	2.77	3.00	0.00	6.00	1.66
Inference (S=16)	5.52	5.00	1.00	11.00	2.31
Evaluation (S=11)	2.89	3.00	0.00	6.00	1.49
Inductive Reasoning (S=17)	5.89	6.00	1.00	12.00	2.48
Deductive Reasoning (S=17)	5.29	5.00	1.00	10.00	2.14

** N= 100; S indicates total scores; SD indicates standard deviation*

Table 6 is the derivation from the results presented in Table 5. As shown in Table 6, the percentages of the students' achievement in the five sub-skills based on the mean scores and the total score were considerably low. Specifically, the students' highest achievement is the analysis and interpretation skills (39.5%). This is followed by the inductive reasoning skills (34.6%), inference skills (34.5%) and deductive skills ((31.1%). In addition, the lowest achievement that the students have was in the evaluation skills (26.3%),. This results indicate that students particularly lack the evaluation skills.

Table 6: Students' Achievement (in percentage) on the CTS sub-skills based on the mean and total score.

Sub-skills	Mean	Total Score	Percentage (%)
Analysis & interpretation	2.77	7	39.5
Inference	5.52	16	34.5
Evaluation	2.89	11	26.3
Inductive Reasoning	5.89	17	34.6
Deductive Reasoning	5.29	17	31.1

The analysis of the students' achievement on the five sub-skills showed a consistent result with the analysis of the students overall achievement on the CTS. Specifically, the results indicated that students have low competency level in the CTS. Further, among the five sub-skills measured, the final year engineering students lack evaluation skills. The low competency level in the CTS indicates that there is a need to relook the approaches and strategies adopted by the universities in developing CTS among their students. This is particularly important for University B that has the lowest overall achievement in comparison to the other three universities.

4.3 The differences of the students' CTS across the four universities

Further analysis was conducted focusing on the differences in the attainment levels of CTS among the final year engineering students across the four universities. The mean and standard deviation of the five sub-skills with respect to the four universities are shown in Table 7. As a whole, students in University A performed better in the analysis and interpretation skills, inference skills, evaluation and inductive skills in comparison to the other three universities.

With respect to analysis and interpretation skills, students from University D have the highest mean (M=3.56) followed by students from University A (M=3.48). While students from University C have a lower mean score (M=2.88), students from University B have the lowest mean (M=1.16).

Table 7: Descriptive Statistics of overall CCTST sub-scores of the final year engineering students across the four universities

Sub-Skills	Uni A *(N=25)*	Uni B *(N=25)*	Uni C *(N=25)*	Uni D *(N=25)*
Analysis & Interpretation	M *=3.48 SD*=1.295	M=1.16 SD=1.068	M=2.88 SD=1.787	M=3.56 SD=1.227
Inference	M =6.36 SD=2.119	M=4.36 SD=1.997	M=5.24 SD=2.314	M=6.12 SD=2.351
Evaluation	M =3.12 SD=1.333	M=2.48 SD=1.686	M=3.12 SD=1.424	M=2.84 SD=1.491
Inductive Reasoning	M =7.04 SD=2.150	M=4.48 SD=1.828	M=6.00 SD=2.887	M=6.04 SD=2.371
Deductive Reasoning	M =5.92 SD=1.869	M=3.52 SD=1.636	M=5.24 SD=2.127	M=6.48 SD=1.787

M indicates Mean, SD indicates Standard deviation

In comparison of the four universities, students' attainment level of CTS at University B were the lowest in comparison to students from the other three universities. The low attainment levels of CTS among students from University B were particularly evident in the sub-skills analysis and interpretation (M=1.16), Inference (M=4.36), Inductive reasoning (M=4.48) and Deductive reasoning (M=3.52). However, for the inference skills, students from all the four universities seem to be positioned at almost the same level as they were insignificant differences between them (The mean score ranges from 2.84 to 3.12).

5. DISCUSSION

Although the sample size was small, the findings provide a baseline to which other measures of assessment can be compared. The students' low attainment level of CTS as indicated by the CCTST total scores may be attributed to a number of factors, in which the most important is the lack of emphasis in the teaching CTS in the Malaysian engineering education system. The lack of emphasis in teaching CTS is consistent with the assertion made by several researchers that the current Malaysian higher education system need to improve their teaching approaches to equip students with the necessary soft skills for employability [3, 19]. It has been a common practice for educators to focus on more traditional learning approaches, teacher-centred delivery methods such as lecturing and presentations are used. In most classroom contexts, arguments do not take place; hence students are not given the opportunities to develop their critical thinking skills. This argument is supported by Tsui [20] who found that the student's critical thinking skills could be developed through group discussion, class presentations and student-led inquiry. Hence, teaching and learning approaches such as problem-based learning and student-centred learning should be adopted because these approaches allow students to have sufficient platforms to develop their CTS as they participate actively in the learning process

Additionally, the low score may also be due to students' unfamiliarity with the assessment tool (CCTST). Although this tool have been proven to be reliable in measuring CTS, they might be less suitable to measure CTS among students experiencing Malaysian local education system. In conducting research on a particular group, it is important for researcher to be sensitive to the culture and norms of the target group. Hence, it is worthwhile to develop an instrument that is sensitive to the local contexts.

The differences in students' attainment level of scores of the CTS's sub-skills across the universities may also be contributed by the approaches taken by the universities to equip their students with the CTS. Although MOHE has specifically outlined the soft skills that the Malaysian universities need to equip their students, there is a need to have further improvement on the development of CTS among tertiary students as their scores showed that they were still below the global standard as stipulated by Insight Assessment California. With respect to the low attainment of students from University B, it is worth to conduct further investigation of the teaching approaches adopted by the university to develop CTS among their students. It was also found that students across all the four universities have low attainment levels for the CTS sub-skills particularly in the evaluation skills. Hence, this finding implies that there is a need for further emphasis on the adoption of teaching and learning approaches that can help students develop their evaluation skills.

6. CONCLUSION

The findings located the cohort of engineering students from the universities lower than the international standard of CTS as stipulated by Insight Assessment California. Furthermore, students across all the four universities did not achieve sufficient competencies in evaluation skills. The results have implications on the curriculum design and the teaching and learning approaches taken by the universities in developing CTS among their students. These findings also provide useful information on the suitability and reliability of the international assessment tool to measure CTS, such as the CCTSS. This study also reports on the low achievement of CTS among students from University B in comparison to the other three universities. The finding provides possible areas for further research to be undertaken.

REFERENCES

[1] M. Lloyd and N. Bahr, "Thinking critically about critical thinking in higher education " *International Journal for the Scholarship of Teaching and Learning,* vol. 4, pp. 1-16, 2010.

[2] R. D. Renaud and H. D. Murray, "A comparison of a subject-specific and a general measure of critical thinking.," *Thinking Skills and Creativity,* vol. 3, pp. 85-93, 2008.

[3] Nurita, Shaharudin, and Ainon, "Perceived employability skills of graduating students: Implications for SMEs.," 2004.

[4] Z. Azami, M. Yuzainee, O. Mohd Zaidi, M. Azah, and M. Norhamidi, "Employers' perceptions and expectation toward engineering graduates: A case study," in *6th WSEAS International Conference on ENGINEERING EDUCATION*, 2009, pp. 23-29.

[5] T. D. Erwin and K. W. Sebrell, "Assessment of critical thinking: ETS's tasks in critical thinking," *The Journal of General Education,* vol. 52, pp. 50-71, 2003.

[6] D. F. Halpern, "Assessing the effectiveness of critical thinking instruction," *The Journal of General Education,* vol. 50, pp. 270-286, 2001.

[7] MOHE, *Module: Development of soft skills for Malaysian institutions of higher learning*. Putrajaya: MOHE, 2006.

[8] D. Moseley, V. Baumfield, J. Elliot, M. Gregson, S. Higgins, and J. Miller, *Frameworks for thinking: A handbook for teaching and learning*. Cambridge: Cambridge University Press, 2005.

[9] The Critical thinking Community. Defining critical thinking [Online]. Available: http://www.criticalthinking.org/aboutCT/define_critical_thinking.cfm

[10] R. H. Ennis, "Critical thinking and subject specificity: Clarification and needed research," *Educational Researcher,* vol. 18, pp. 4-10, 1989.

[11] S. C. Fisher and V. A. Spiker, "A framework for critical thinking research and training," Report prepared for the U.S. Army Research Institute, Arlington VA2000.

[12] American Philosophical Association, *Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction*. Millbrae, CA: California Academic Press, 1990.

[13] P. Facione, *Critical thinking: What it is and why it counts*. Millbrae, CA: California Academic Press, 2006.

[14] C. Ornstein and P. Hunkins, Eds., *Curriculum: Foundations, principles, and issues*. Boston: Allyn & Bacon, 2004, p.^pp. Pages.

[15] B. Hassan, O. Mohd Zaidi, M. Zainal, A. A. Abang Abdullah, A. A. Badrulhisham, H. Abdul Hamid, N. M. Nik Abdullah, H. Azmi, and M. R. Zaidi, "The Future of Engineering Education in Malaysia," Department of Institutions of Higher Education Management, Ministry of Higher Education, Kuala Lumpur, Malaysia2007.

[16] P. Facione, "The California Critical Thinking Skills Test - Form 2000," ed. Millbrae, CA: Insight Assessment/ The California Academic Press, 2000.

[17] P. Facione, N. Facione, S. Blohm, and C. Giancarlo, *The California Critical Thinking Skills Test Manual*. Millbrae, CA: California Academic Press, 2002.

[18] G. R. Pike, "The California Critical Thinking Skills Test," *Assessment Update,* vol. 9, p. 10, 1997.

[19] M. Y. Aida Suraya, H. Ramlah, A. T. Rohani, M. N. Sharifah, I. Habsah, W. A. Wan Zah, and A. B. Kamariah, "Problem solving abilities of Malaysian university students," *International Journal of Teaching and Learning in Higher Education,* vol. 17, pp. 86-96, 2006.

[20] L. Tsui, "Courses and instruction affecting critical thinking," *Research in Higher Education,* vol. 23, pp. 421-441, 1999.