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EPL Class Design for Understanding the Concept of Effective Program Coding

Hee-Won Yun and Sung-Uk Choi
Department of Computer Science, Incheon National University, Academy-Ro,
Yeonsu-gu, 406-772 Incheon, Korea

Abstract: This study has attempted to design a classroom lesson plan with EPL with the purpose of understanding the effective coding concept for elementary students. To do this, program coding is defined in the first place. Then, key elements of learning coding were extracted and analyzed. Based on the outcomes of extraction in the following level, lesson plan was created and applied to provide effective coding lesson. Then, the levels of understanding and interest in the coding concept were analyzed by comparing before and after the class in order to prove the validity of the lesson. Experiments were divided into two groups; experimental group using EPL (scratch) and control group using flow chart and the results of the class were compared and analyzed. Results show that the experimental group with the scratch had higher level in understanding the coding concept and interest in coding than the group lessoned with the flowchart.

Key words: Scratch, EPL, educational program, coding, interst

INTRODUCTION

The 21st century is often called the knowledge information society. Computers are the most important element of knowledge and information society and changes of the times and the development of information technology have made computer education even more important (McCaskill, 2013; Dominiczak, 2013). For the pupils in the primary school in UK, computing will be replaced by ICT at all levels of education as a part of a national standard reform from September, 2014 which focused on learning to code and solve problems by computing (Jung *et al*., 2006). Also in USA, K-12 Computer Science Standards was formulated in 2011, focusing on the computerized thinking. The computer science national standard is divided into in five strands: computational thinking, collaboration, computing practice and programming, computer and communications devices, community, global and ethical impacts. China has required information and communication technology to be a mandatory course to elementary, middle and high schools, since 2000 and has implemented this policy, it has designated IT as a mandatory course to elementary school in 2001, middle school in 2003 and high school in 2005. Korea has emphasized on enhancing self-directed learning ability by cultivating creativity and information capacity to be prepared for the information society through distributing the 2015 revised guidelines on the operation of information and communication technology education for elementary, middle and high school.

Program development is process of collecting information for problem solving, presenting various solutions and solving problems through algorithms. In this way, coding learning for programming improves high thinking ability such as creativity, problem solving ability and logical thinking ability so it would be a future oriented ICT education (Ju-Young and Sung-Uk, 2013; Su-Jin and Hong-Jin, 2013; Lee, 2015; Brain, 1997). This study focuses on designing class lesson for the purpose of understanding the concept of coding, rather than investigating the logical thinking ability and problem solving ability of EPL which has already been proved. The class lesson is designed with content which will be easily understood by elementary school students whose organizational and logical thinking skills are still at the beginning level. In order to analyze the results, classes are conducted with flowcharts which are considered as a universal method to give a lesson for coding concept for comparison and analysis.

Literature review: Education Programming Language (EPL) was developed as a tool for programming learning and initially, it was developed as a basic language for proceeding with a professional program such as C or Java. After that it is used as a classroom learning tool to improve logical/procedural thinking ability through coding training rather than it is used to develop application. Therefore, the recent EPL is mainly composed of a web-based environment and a visual interface to enable assembling block/graphic objects like

Corresponding Author: Sung-Uk Choi, Department of Computer Science, Incheon National University, Academy-Ro, Yeonsu-gu, 406-772 Incheon, Korea

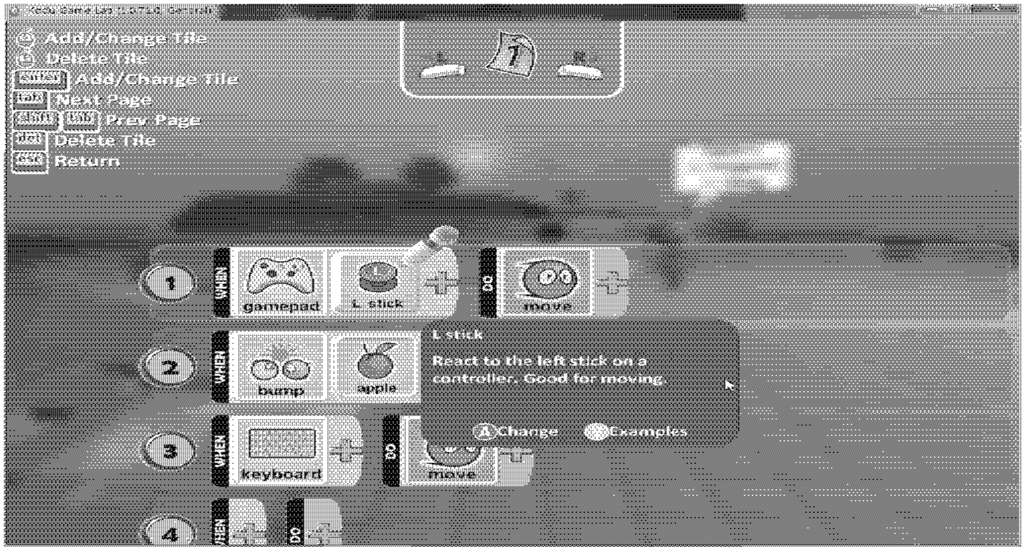


Fig. 1: KODU Game Lab Software interface

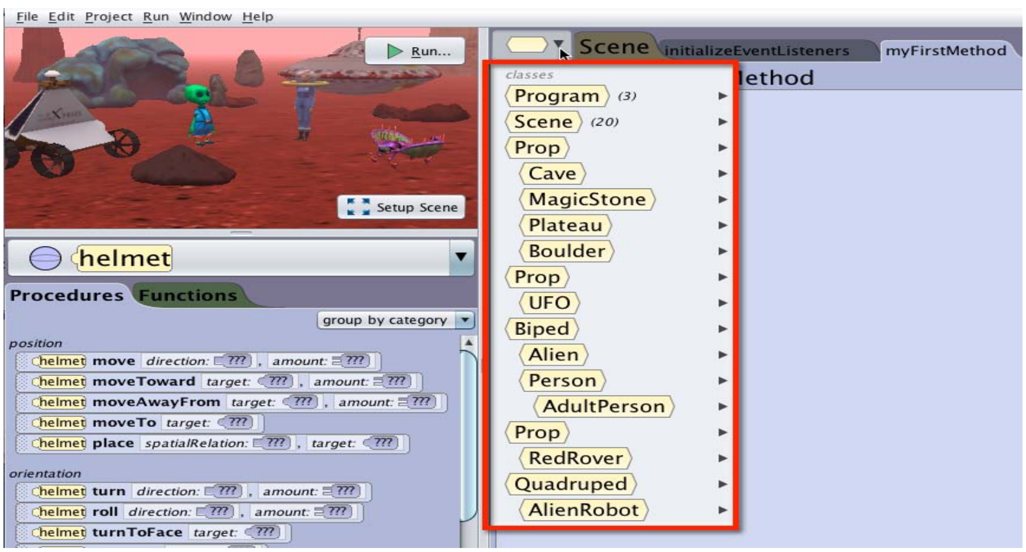


Fig. 2: Alice software interface

Lego blocks for programming so that anyone can easily use and understand them (Clements, 1999).

Blockly: It is a web based block programming language like scratch, developed by Google. It can convert the developed program into JavaScript, Python, PHP, etc. and it has advantages to use as a basic step prior to entering professional programming language.

Logo: It is a language of LISP and an interpreter language for programing that uses basic robot. It was developed for educational use at the MIT Institute of Artificial Intelligence.

Kodu: Developed by Microsoft as a 3D visual programming language, it is effective for a simple but versatile game and storytelling type programing (Fig. 1).

Alice: It is a 3D object programming language created by Carnegie Mellon University. It is effective to understand about simple game and animation production. Because, it applies the object as a basic element, it is effective in the pre-steps before learning the object-oriented language (Fig. 2).

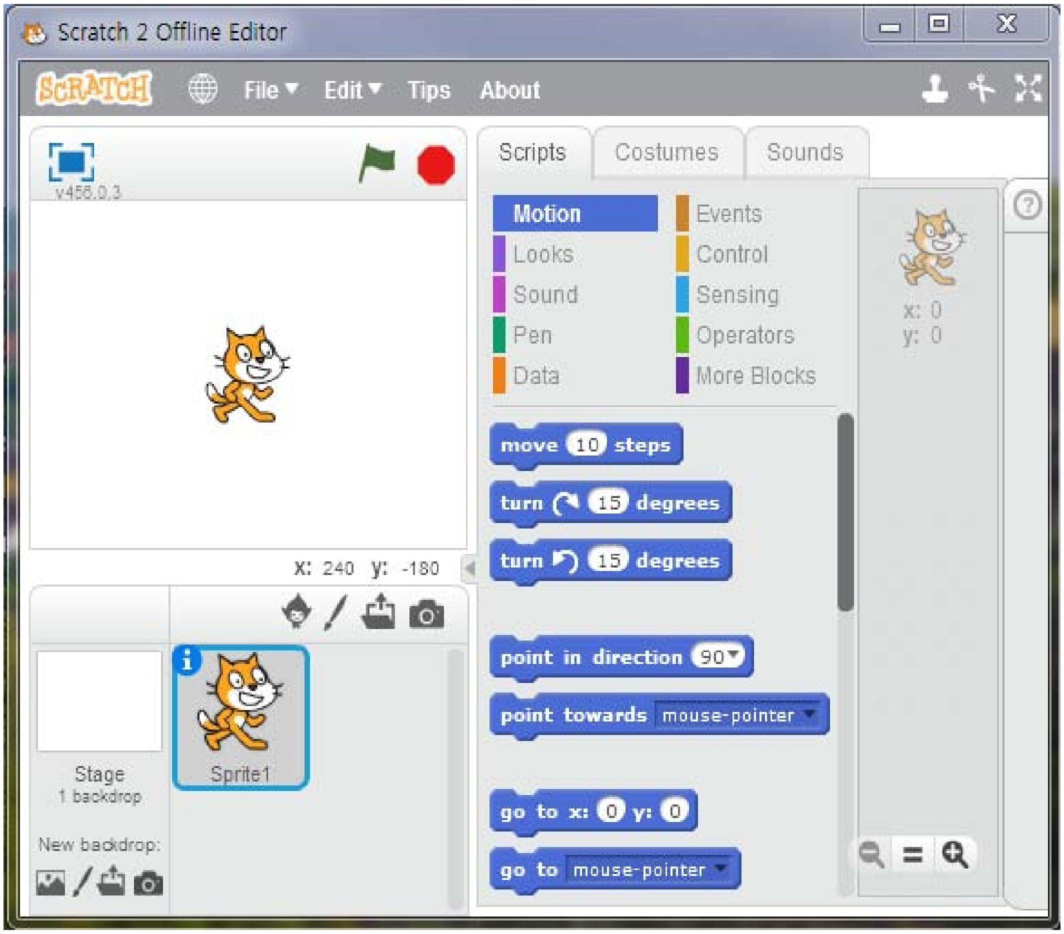


Fig. 3: Scratch software interface

Scratch: Scratch was developed by the research team at MIT media lab in 2007, designed by Mitchel Resnick and based on Squeak eToy. It is developed for programming education and supports object orientation. It is distributed free of charge through the homepage. Scratch has been developed to teach young children the basic concepts and algorithms of programming and games and animations can be easily produced with a variety of multimedia support. Recently, scratch junior for preschooler has also been introduced (Fig. 3).

MATERIALS AND METHODS

Class design

Definition of the elements of program coding: The elements of program coding are understood as both the common programming elements covered in commonly used languages and other excerpts from the study of programming language theory and software design and implementation which are considered as learning elements of the coding process. The common coding learning elements are summarized as follows.

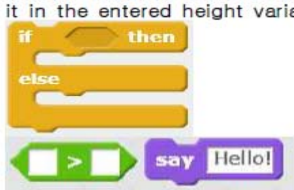
Learning elements of elementary students to understand coding concepts: In this study, based on Table 1 the elements of programming learning for elementary school students are summarized as Table 2.

Key class contents of each class to understand the coding concept of students: Table 2 based on the coding learning elements suitable for the elementary school level, key class contents of each class to understand and learn the coding concept of elementary students are designed as Table 3.

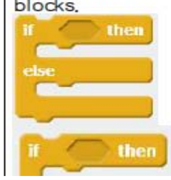
Class plan for each scratch coding class: Table 3 based on the class plan of the scratch coding, a total of eight class plans were designed. Figure 4 is presented as an example of teaching and learning class of scratch coding.

Scratch Teaching Plan

<table>
<tr><td>Chapter</td><td colspan="3">no. 5 (40 minute)</td></tr>
<tr><td>Subject</td><td colspan="3">Say~ Yes or No!</td></tr>
<tr><td>Objectives</td><td colspan="3">1. Judge the value of the input variable and execute the instruction satisfying the condition.</td></tr>
<tr><td>Programming concept</td><td colspan="3">Conditional statements , Comparison operators</td></tr>
<tr><td>Critical block</td><td colspan="3">
</td></tr>
<tr><td>Step</td><td>Teaching and Learning Activities</td><td>Min -ute</td><td>Note</td></tr>
<tr><td>Intro</td><td>• Greetings
• Identifying Learning Objectives</td><td>5</td><td>Distributing workbooks</td></tr>
<tr><td>dep</td><td>• Explaining the concept of comparing operators
– Operators used to determine the bigger or smaller of a formula
–>, <,> =, <=, =, <> are explained
• Examples
– Create a script that allows people to ride only who are over 140 cm in height by asking the height of them in the amusement rides.


Use the block to ask the height and save it in the entered height variables.


Combine the blocks and write a script that can say "you are allowed to enter" if the height is over 140cm, otherwise say "Come when you become a little taller ㅠㅠ."
• Example coding


• Applications
– Create sprite that ask whether people had lunch, if the response is yes, let it say "Let's go for a tea", or if no, "Let's go and have lunch".</td><td>25</td><td>– Explain the concept of conditional statement and explain by comparing two blocks.


– The concept of comparison operator and More than/Below/Excess/ Under explained.
– The answer to the application question should be directed only to Y or N.</td></tr>
<tr><td>Fin</td><td>• Review today's training
• Notice of next time contents</td><td>10</td><td>Arrangement and departure guide</td></tr>
</table>

Fig. 4: Example class plan for scratch coding

Table 1: Programming coding elements

Construction	Coding element	Construction	Coding elements
Operator	Operator-unary operators, arithmetic operators, shift operators, relational operators, bitwise logicaloperators, general logic operator, 3-ary operator, assignment operator, etc. Operator precedence, comma, condition and type conversion operations	Type	Type declaration enumerated type basic data types: number, boolean, characters, structured type: array type conversion
Variables	Define, declare and use variables-naming declaration, attributes identify, reference, value	Function	Definition of function calling a function user-defined functions. Recursive calls, passing parameters
Constants	Constants-key codes, mathematical constants numbers, letters, strings, symbols	Object	Definition of object methods and properties of the object
Expression	Arithmetic expression equation string expressions	Input/output	Input/output with standard input/output device. Open and close files. Input/output through file. Object I/O
Control	Conditional statements if, else, else if, switch case loop statements while for, do~while escape statements break, continue, goto	ETC	Multidimensional arrays, pointers, linked lists-structures and unions preprocessor, compiler

Table 2: Elements of programming learning suitable for elementary students

Coding element	Elements of programming learning suitable for elementary students	Coding element	Elements of programming learning suitable for elementary students
Syntax	Common rules governing the programming language	Formula	Arithmetic expression, logical expression
Operator	Operator Unary, arithmetic (+, -, ×, ÷) Relation (<, <=, >, > =) logical (and or) General logical (if ~) conditional ternary operator (if ~ expr1, expr2) assignment operator precedence	Control statement	Conditional statement if statement (if ~) else if statement (if ~ or ~) loop statement while statement (if ~) for statement (repeated until ~)
Variable	Definition, declaration and use of variables-naming, declaration,	Input/output	Input/output with standard i/o device
Constants	Numeric, character		

Table 3: Class plan of the scratch coding

Periods	Contents	Concept elements
1	Understanding coding concepts. Scratch introduction and screen composition explanation. Learn how to use scratch	
2	"Speaking (form) move (action)" understanding sequential structure using blocks	Sequential structure
3	"Variables, arithmeti coperations" using blocks to calculate sequentially	Sequential structure, variables, arithmetic operators
4	Enter variables using the "ask and wait, answer" block and get the widths of the various shapes	Constants, arithmetic operators
5	According to the value of the input variable, "compare operation, if not", execute the command that satisfiescondition by using block and comparison operator	Conditional statements, comparison operators
6	Depending on the value of the input variable, "logical operation, if ~" Execute the command according to the condition using block and logical operator	Conditional statements, logical operator
7	Use the "repeat to" block to find the sum of numbers from 1-100	A loop
8	Repeat until "if" or "block" to create a quiz game	Conditional statements, a loop

RESULTS AND DISCUSSION

Application of research and analysis: With the aims of verifying the effectiveness of the class design for teaching and learning the coding concept of elementary students, sample group were collected out of 5th grade Korean elementary students who did not have coding learning experience and wished to attend the class for understanding the coding concept. One group is an experiment group and the other group is the control group. Subjects of the research are 20 students, respectively. In order to determine the homogeneity of the two groups, preliminary test was conducted using the interest in programming questionnaire and questionnaire for programming concept's for the features of this research.

And the actual coding classes were provided into two groups (experiment group and control group) for a total of 10 weeks. The experiment group was given a class with scratch whereas the control group was with flowchart, regarding the understanding the coding concept. Class materials, class duration and environment are all identical. After the experiment, the level of understanding of coding concept and the degree of interest in coding of the respective group were measured as a mean of post-test by using "understanding coding concept appraisal sheet" and "questionnaire for coding interest".

Table 4 shows the result of preliminary test on the conceptual understanding of experimental group and control group. It indicates that average of the experimental group was 0.95 whereas average of the control group was 0.85.

Table 4: Class plan of the scratch coding

Groups	Mean	SD	t-value	p-value
A (n = 20)	0.95	0.68633	0.466	0.644
B (n = 20)	0.85	0.67082		

Table 5: Preliminary test of coding interest of experimental group (A) and control group (B) (*p<0.5)

Items	Groups	Mean	SD	t-values	p-values
Interest 1	A (n = 20)	2.5500	1.27630	-0.835	0.409
	B (n = 20)	2.9000	1.37267		
Interest 2	A (n = 20)	2.5500	1.05006	0.917	0.365
	B (n = 20)	2.2500	1.01955		
Interest 3	A (n = 20)	1.6000	0.59824	-0.767	0.448
	B (n = 20)	1.7500	0.63867		
Interest 4	A (n = 20)	2.1500	1.13671	1.582	0.125
	B (n = 20)	1.7000	0.57124		
Interest 5	A (n = 20)	2.5000	0.82717	1.300	0.201
	B (n = 20)	2.1500	0.87509		
Interest 6	A (n = 20)	2.5500	0.99868	1.374	0.177
	B (n = 20)	2.1000	1.07115		
Interest 7	A (n = 20)	2.9500	1.14593	-0.543	0.590
	B (n = 20)	3.1500	1.18210		

Table 6: Understanding pre-post coding concept of experimental group (A) and control

	Mean				
Groups	Pre	Post	SD	t-values	p-values
A (n = 20)	0.95	8.00	1.39454	-22.609	0.000
B (n = 20)	0.85	5.40	0.94451	-21.544	0.000

The experimental group was 0.1 point higher than the control group but the insignificant difference was illustrated. Table 5 shows the preliminary test result in graph on the interest in coding of experimental group and control group by each item. As a comparison result of two groups, there was no statistically significant difference for each item. It has proved that the experimental group and the control group selected by the researchers are homogeneous in terms of the interest and understanding levels in coding.

Table 6 shows the result of comparing the mean of understanding of coding concept after conducting the experimental. When reviewing the preliminary and post results, differences between the experimental group and the control group on the coding understanding, it is confirmed that both groups are significantly improved. However, it indicates that the understanding degree of the experimental group is improved statistically significant compared with the control group.

When comparing the differences in interest in coding by reviewing the preliminary and post results of each group, Table 7 indicates that the interest in coding of all items in the experimental group is improved statistically significant. However, Table 8 shows that only the item 1 was significantly improved, the average decreased in all the items except item 1 and the mean was significantly lower in items 3, 6 and 7. Thus, it indicates that experimental group with the lesson with scratch was high in the level of the interest in coding.

Table 7: Comparison of pre-post coding interest of experimental group (*p<0.5)

Items	Division	Mean	SD	t-values	p-values
Interest 1	Pre	2.5500	1.27630	-7.336	0.000
	Post	4.8000	0.41039		
Interest 2	Pre	2.5500	1.05006	-5.395	0.000
	Post	3.6500	1.03999		
Interest 3	Pre	1.6000	0.59824	-10.341	0.000
	Post	3.8000	1.10501		
Interest 4	Pre	2.1500	1.13671	-4.807	0.000
	Post	3.6500	1.13671		
Interest 5	Pre	2.5000	0.82717	-4.156	0.001
	Post	3.5000	1.05131		
Interest 6	Pre	2.5500	0.99868	-3.018	0.007
	Post	3.4500	1.19097		
Interest 7	Pre	2.9500	1.14593	-3.053	0.007
	Post	4.0000	1.12390		

Table 8: Comparison of pre-post coding interest of control group (*p<0.5)

Items	Division	Mean	SD	t-values	p-values
Interest 1	Pre	2.9000	1.37267	-6.430	0.000
	Post	4.8500	0.36635		
Interest 2	Pre	2.2500	1.01955	1.377	0.185
	Post	1.9000	1.16529		
Interest 3	Pre	1.7500	0.63867	2.854	0.010
	Post	1.4500	0.51042		
Interest 4	Pre	1.7000	0.57124	1.831	0.083
	Post	1.5500	0.60481		
Interest 5	Pre	2.1500	0.87509	2.015	0.058
	Post	1.7000	0.73270		
Interest 6	Pre	2.1000	1.07115	3.240	0.004
	Post	1.5500	0.68633		
Interest 7	Pre	3.1500	1.18210	4.292	0.000
	Post	2.3500	0.98809		

We show a simple and reasonable way of improving multiple alignments for TM protein data sets by the pre-treatment of sequence selection at the expense of fewer sequences. In the process, the indices on the location of TMS and on the gap insertion are valuable as long as the TMS regions can be predicted correctly. We can assume that the selected proteins have high structural similarity to each other.

The sequence selection seems to be necessary in the preparation of the data set for the conventional multiple alignment at the present time. The sequence identity around 20% seems to be significant in the comparison of TM protein sequences, although the number of examined data sets is not sufficient yet. The results, partly containing the sequences in twilight zone, on the sequence alignments of TM proteins merit further study. More examinations and refinements of the method are required.

CONCLUSION

This research was conducted to design the class with scratch an educational programming with the aims of understanding the coding concept of elementary students and to investigated the effectives of designed class design.

First, scratch was found to be effective in enhancing understanding of coding concepts of elementary student. In both experimental and control groups, the understanding of the coding concept was improved but the mean difference between the two groups showed a significant difference. Therefore, it is determined that the understanding of the coding concept using scratch is effective.

Second, scratch was found to be an appropriate program to enhance interest in coding. As it is an educational programming language, interest in coding was significantly improved with the functions such as easy operation and multimedia support before the experiment was conducted. It is expected that these findings of improved interest in coding be of great contribution to teach and learn other programming languages in the future.

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REFERENCES

Brian, H., 1997. Science Logo Style. 2nd Edn., MIT Press, Cambridge, Massachusetts, USA., ISBN: 9780262581516,.

Clements, D.H., 1999. The future of educational computing research: The case of computer programming. Inf. Technol. Childhood Educ. Annual, 1999: 147-179.

Dominiczak, P., 2013. Michael Gove: New curriculum will allow my children to compete with the very best. Telegraph Media Group Limited, UK. http://www.telegraph.co.uk/education/educationnews/ 10166020/ Michael Gove new curriculum will allowmy- children-to-compete-with-the-very-best.html.

Ju-Young, S. and C. Sung-Uk, 2013. Comparative analysis study on the after-school operation types of elementary schools. Soc. Convergence Knowl. Transac., 1: 65-74.

Jung, Y.W., J.Y. Lee and K.D. Jung, 2006. A design of DBaaS-based collaboration system for big data processing. Intl. J. Adv. Smart Convergence, 5: 59-65.

Lee, J.Y., 2015. Energy improvement of WSN using the stochastic cluster head selection. J. Inst. Internet Broadcast. Commun., 15: 125-129.

McCaskill, S., 2013. New national curriculum to teach five year olds computer programming. Ukhttp://www.techweekeurope.co.uk/news/national-curriculum-ict-education-computing-121214.

Su-Jin, P. and K. Hong-Jin, 2013. A study on method of information education for second life. Soc. Convergence Knowl. Transac., 2: 87-91.