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**ME Model and FITTINGS Principle: A Pedagogical Approach to Multimedia Courseware Development for Smart Schools**

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**Abstract**
The paper attempts to highlight the conceptual model of ME which is based on the learning and pedagogical approaches deemed suitable for the learning and teaching of Mathematics. The design of ME courseware is also based on FITTINGS principle which uses six guiding criteria in the designing process as follows: Flexible, Indirect, Thematic, Technological, Interactive, Navigative, Gaming and Simulative. A prototype of this idea has been developed to prove the viability of this concept. The prototype covers the whole curriculum of Mathematics for Standard One primary school children. As a tutoring tool, ME will not only make it suitable for teachers to use it to enhance their teaching but also more importantly, it can be used by students for individualized and self-paced learning suitable to be used for ‘smart schools’. The prototype is developed totally using JAVA that makes it possible for it to be placed in the Internet. It is hoped that this tutoring model for the teaching and learning of Mathematics will prove beneficial to both students and teachers alike and serve as a framework for future development of multimedia based tutoring system.

**Keywords:** Smartware, Smart School, Pedagogy, JAVA

**1. Introduction**

The creation of the Multimedia Super Corridor (MSC) as a government initiative, is a gift not just to the world but to the citizens of Malaysia (Mahathir Mohammad, 1997) to ensure that majority of Malaysians can benefit from the technological advancement of the country. The MSC has included as one of its flagship applications: the Smart School flagship. What is a Malaysian Smart School? As has been defined in the Smart Schools Conceptual Blueprint (1997), it is "a school that delivers education in a dramatically better way to significantly enhance the achievements of the goals of the National Philosophy of Education, utilizing technology as the prime enabler and supported by appropriate people, skills, policies and processes. It uses information to select and implement effective tools and practices accompanied by the necessary organizational support and continuous professional development."

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1.1 Theoretical Background

To deliver education in a better way has always been an educational goal which has very often also led to the disappointment for those who tried to achieve it. What more to deliver education in a dramatically better way. The school setting is not in a position to equip the future citizens with all the knowledge they need to serve them a lifetime, if the traditional conception of knowledge is taken. However, if one is to see knowledge and competence as products of the individual's conceptual organization of their experience, the teacher's role will shift from dispensing 'truth' to guiding the students in the conceptual organization of certain areas of experience (von Glaserfeld, 1987). If that is so, then the main task of the school of today is, above all, to teach the students how to learn. In this respect, two educational principles have proved advantages: integration of school subjects with real life experience and learning by doing.

The results of Mathematics education have constantly revealed a weakness in the students to understand mathematical concepts which continuously resulted in low achievements of the students. The Prime Minister in one of his addresses to the people (Mahathir Mohamad, 1997) voiced his concern that new ways should be thought to enhance the teaching of Mathematics, perhaps with the use of the new technology. The consequence of this was the introduction of CRFP (Concepts Requests for Proposals) for organizations to submit proposals on how to teach core subjects (Mathematics, Science, Bahasa Malaysia and English) using multimedia technology. It was with this in mind that the a group of lecturers from the Faculty of Information Science and Technology decided initially to carryout this project with the help of a local IT company.

Considerable emphasis in learning Mathematics in recent years has been placed on the desirability of understanding, rather than being able to repeat remembered routines and demonstrate particular basic skills. How learners actually learn mathematics as previous research has shown (Orton and Frobisher, 1997), is a complex issue. They have said that it is possible neither to separate understanding from memory nor to explain what is meant by 'understanding mathematics' (Selinger, 1997). In relation to memory, in cognitive science, it is thought that the more readily one remembers, the easier it is to think, because there is little delay caused by searching for what can be likened to some missing piece of a jigsaw puzzle, and because less effort is required in pulling essential information to the forefront of the mind. Pupils whom teachers regard as being particularly intelligent usually have swift and reliable retrieval systems, in that they recall things quickly and accurately.

Although it is still debatable, it seems likely that a good memory is only a part of what is involved in understanding. Early research by Skemp (1976) have introduced to us the notion of two kinds of understanding mathematics: instrumental and relational. When learners are learning many of the procedures of mathematics, such as adding two fractions or multiplying two three-digit numbers, it is possible for them to think they understand because they can nearly always achieve the correct answer. Often, learners will claim that they understand when all they know is what to do, which is certainly dependent on memory. What they do not necessarily know is why they do it, or, in other words, why what they do produces the correct sum of the two fractions, or the correct product of the two three-digit numbers. This latter kind of understanding seems much less a feature of memory than knowing what to do. To know what to do is to have learned 'instrumentally'; to understand why is to have learned...
‘relationally’. Even with this theory the teacher cannot assure understanding among their learners (Pimm, 2000). Various other theories and methods have been explored, like methods by Cockeroff (1984), problem solving methods through Pictorial and perception of patterns (Orton, 1999).

This courseware was designed will all this underlying cognitive, and general learning theories as well as specific learning of mathematics theories in order that the courseware will really help learners learn mathematics in a more meaningful way – to a point that they not only learn through memory but they also learn through understanding.

1.2 Aim and Objectives of the ME Project

Thus, the main aim of the project is to develop a multimedia in education courseware to enhance learning of Mathematics. The objectives of the ME Project were as follows:

1. To develop a conceptual model on ME that would include all levels of learners taking into consideration the different learning styles and preferred modalities.
2. To develop a courseware with local content so that it is culturally close to the origins of learners to ensure that they can easily identify with the contents of the courseware.
3. To develop a courseware that will allow slow learners to reflect and redo certain topics again in a different approach through the Ulangkaji or Revision module.
4. To develop a courseware that will allow fast learners to carryout enrichment exercises through the Pengayaan or Enrichment module.
5. To develop a courseware that possesses a navigational approach that will allow learners to be independent and take responsibility of their learning but at the same time know where they are on each screen that they are working on.
6. To develop a courseware that would help learners relate mathematics with real life.

2. System Overview

From the top level view the basic architecture of the smart school system might look like in Figure-1.0 below. The system comprises three major components as follows:

2.1 Student Model

One of the important characteristics of the courseware is its ability to collect and store information on learners’ performance as the learning (using the system) progresses. The system uses this information to arrive at the knowledge on students’ performance. Information on learners’ progress and knowledge on students’ performance constitute student model component of the courseware. Basically, student model is a representation of learner’s knowledge in the system embedded in the Built-in Database of learner’s profile and performance containing data on the following categories: Biodata of Learners; and Performance Records of Learners.

A number of functions are built into the Database Module that perform the following: store the necessary records of learners or groups; validate the identity of student or group during login; collect and store relevant data during the login sessions; provide relevant data to the Assessment Module and the Life-Time Data Base.

In particular, the built-in Database module contains the following data elements: Learner Information: Biodata, Learner ID, Password, Class code, Name, Race, Sex; Login Session:
Session ID, Learner ID, Start Time, Finish Time, Date; *Performance*: Learner ID, Session ID, Courseware ID, Question number, Number-of-time Attempted, Number-of-Right Answers.

### 2.2 Instructional Modules

The Instructional Modules component of the courseware system stores sets of instructional materials. Besides instructional materials the Instructional Module component also stores the following information: Courseware Description and Learning Objectives; and Knowledge Network of Learning Objectives.

Courseware Information contains the following data items:

i) Courseware Description: Courseware ID, Standard/Form, Subject Name;

ii) Courseware Objectives: Courseware ID, Unit number, Level number (1/2/3), Learning Objectives;

iii) Question Characteristics: Question number, Unit number, Marking Weight, Number-of-subquestions, Module code, Courseware ID;

iv) Knowledge Network of Learning Objective: Network of Learning Objectives embedded in the courseware.

### 2.3 Assessment Module

The Assessment Module represents an important component of our courseware. Assessment module incorporate functions that analyse the data (from Database of Learner Profile and Performance) and produce relevant reports, such as: individual learner’s performance; overall learners performance; problem areas in mastery of contents. Based on the reports from the assessment module, the system generates courseware modules that are suitable for individual learners.

The built-in Database and the Assessment modules are designed with the aim of making the courseware flexible and individualised enough to accommodate the differences in learning styles and the rates of learning of individual learners. It also ensures that every learner is provided the appropriate learning materials and opportunity. These built-in Database and Assessment Modules are designed in such a way to support the master/overall Smart School Assessment System and the Smart School Life Time Database System. Bearing in mind that learners have different styles and rates of learning, the courseware is designed to be flexible and individualised. The courseware is imbedded with two built-in modules to enable it to meet the above objective.
3. Developing Computer Coursewares as Teaching And Learning Media

The most distinctive feature of the smart school is identified to be the teaching and learning environment shaped by four main factors: curriculum, pedagogy, assessment, and teaching-learning materials. These four factors should be aligned in a mutually reinforcing, coherent manner with the support of technology in order to be highly effective.

As this paper will focus on the pedagogical aspect of the system the technical aspect of the system will not be dealt with in detail. The smart school pedagogical approach should make learning more interesting, motivating, stimulating, and meaningful; involve the children’s minds, spirit, and bodies in the learning process; build basic skills to prepare children for greater challenges over time; and cater for a range of needs and capabilities among students. This seems to be quite a far pledge ambition. In trying to match these requirements, the design of ME courseware was based on some principles, called FITTINGS (Tengku Mohd. et.al, 1999), which uses six guiding criteria in the designing process as follows:

Flexible: based on the cognitive flexibility theory that learning need not be in a linear manner but should be flexible enough to allow learners to choose what and when they want to learn, and the mode of delivery should take into consideration the various type of learners;
Indirect: meaningful learning can happen when the subject is indirectly introduced through means that the learners can relate to their lives experiences;

Thematic: the subject matter could be delivered indirectly through learning scenario based on certain theme to get the involvement of the learner in mind and spirit;

Technological: use of available technology to enable the teaching and learning process to take place more effectively;

Interactive: incorporate an appropriate level of interactivity based on the subject matter to get the mental and physical involvement of the learner;

Navigational: provide a user friendly interface that allow the learners to navigate and choose the subject matter and indicate their current position in the courseware;

Gaming: incorporate games in the delivery of knowledge to make learning enjoyable and fun.

Simulative: incorporate simulation in teaching and learning to help students in exploring different aspect of subject matter by altering various parameters in the models;

3.1 Development of Multimedia Coursewares

Development of multimedia coursewares can be considered along a spectrum. At one end of the spectrum is the ‘traditional courseware’ that provides the learner with a courseware that is very much a book metaphor with very structured textbook based learning materials (Blitz, 1973) with lots of exercises to be done as drills and tests in the learning process.

At the other end of the spectrum is what one could term as ‘dynamic courseware’ that provides the learner with a less structured indirect learning materials with practices that are fun and interactive and permits the learner to learn independently when deemed necessary at the learner’s own pace. Here the system interacts with the learner and helps the learner be on the appropriate modules based on the learner’s capability. Teacher intervention is still important but the level of involvement will depend on the strategy to be taken by the teacher. Teacher can take total control in the teacher centered environment and use the courseware only during certain parts of the teaching as a teaching aid or the teacher can have minimal intervention and plays the role of a mentor or a facilitator in a student centered environment and use the courseware as a tutoring system. The concept of traditional and dynamic courseware can be associated with traditional and dynamic classroom. Traditional classroom is one that is characterized as authoritative teaching, large group instruction, a curriculum prepared to be used by all students irrespective of their capability and a very much teacher centered approach. On the other hand, dynamic classroom is one that is perceived as a style of teaching that is rich in interactive learning (Kolcheva & Sendova, 1993), that promotes the development of critical enquire, curiosity, exploration, application and problem solving. In other words, a dynamic classroom is very much a learner centered or self-directed learning approach.

One of the most efficient ways of changing traditional classrooms into dynamic or open learning environments is through computer technology (Wright, 1994). The major obstacles to the adoption of the new dynamic ideas in the educational framework is the fear of failure. Computer technology can create an environment that allows for exploration and encourages
originality and creativity as well as failure if not conducted well. The crux of the matter lies in the learning materials: in this case the creation of a dynamic courseware. A well researched and a pedagogically sound model of a dynamic courseware can create a true dynamic CAL environment where the learner can progress according to his/her own pace, without fear of embarrassment. This also means that learners can learn to be self-reliant and take responsibility of their own learning.

4. Design And Development of a Dynamic Courseware : ME

The creation of the Multimedia Super Corridor (MSC) as a government initiative, is a gift not just to the world but to the citizens of Malaysia (Mahathir Mohammad, 1997) to ensure that majority of Malaysians can benefit from the technological advancement of the country. The MSC has included as one of its flagship applications : the Smart School flagship. This means that The two educational principles mentioned earlier, other learning and cognitive theories, the conception of a dynamic courseware and other constructs were built as a basis of the design and development of the prototype: ME.

4.1 Conceptual Model of ME

The conceptual model of ME is as indicated in Figure 1.1. (Halimah et.al., 1998) As can be observed, ME is developed as a multimedia based tutoring system that not only incorporates all the various media, but also the pedagogical and andrological aspects of learning and teaching. This is to ensure that the system developed can actually help students learn Mathematics more effectively. The indirect learning method using the thematic approach is one of the ways to relate the subject to the real lives of the learners. In this prototype, the theme chosen is ‘Taman Negara’ or National Park; this means that the mathematical problems posed to the students are whenever possible related to objects, sites, scenes related to the theme, Taman Negara so that learners can clearly see the connection between learning mathematics and their everyday lives.

The media chosen for presentation of the content of the courseware is multimedia and this means that the mathematical knowledge and problems is presented not just in text but also in graphics, video, audio, numerics, and animation. This is in line with the element of fun in learning as indicated also in the model. The element of fun has many a times been iterated by educators and educational philosophers like : Rousseau , Montessori , Froebel , Pestalozzi and Piaget as stated by Morrow (1993). Their research as mentioned in her book, has shown that learning becomes more interesting and more meaningful when learners enjoy and find that undertaking the learning task or activity is fun. To create this element of fun in the package, some ‘gaming’ elements is implanted in some of the problems posed for learners to solve. The careful choice of colourful graphics, the moving pictures (videos) and the animation like ‘the flicker of a bonfire’, the ‘twinkle of the stars’, the ‘frogs jumping’, the ‘monkeys falling coconuts’, the ‘birds flying’, the ‘turtles turning on their backs’, based on the theme are all also part of the pedagogical
approaches to sustain learners’ interest in the package. The learners also receive positive reinforcement from the system to motivate them through voice (with remarks like ‘tahniah’ or congratulations, ‘bagus’ or good, ‘kurang tepat, cuba lagi’ or not quite right, try again and ‘maaf, kurang tepat’ or sorry, not quite right). This is another element in the model to ensure the system adopts some ‘tutor’ characteristics so that learners ‘feel’ like he or she has a personalized tutor at his or her attention.

The other important element in the model is local content. This is important because as indicated earlier, learning becomes more effective when it is related to real life. Thus only if the content is presented suitable to the local culture and way of life of the learners can one assume that learning has taken place more effectively as learners can identify and relate themselves much more easily to the content taught. Moreover, learning becomes more meaningful because learners can then relate to the content and see the importance of the topic taught in relation to their real life. The other element of the model is the component of the national curriculum. ME ensures that the package is based on the national curriculum. This means that the syllabus are studied thoroughly and lesson plans are developed before they are carefully transferred into suitable storyboards for implementation. This also means that the National Education Philosophy or Falsafah Pendidikan Negara is also incorporated in the content. One of the important aspects of the education philosophy that is consciously instilled
in this tutoring system is the integration of moral and religious values or nilai-nilai murni into the content of the package.

The other important element in the model is the navigational approach adopted in the system. ME adopts what the researchers termed as **perpetual unique navigation**. This means that all important icons based on the existing modules of the system are constantly presented on the screen. Although not all the icons are activated, nevertheless they remain on the screen to enable the learner to know where they are at and where they can navigate next. The screen would also be able to ‘tell’ the teacher the level the learner is at and the actual learning outcome the learning is attempting. This approach ensures also, that learners do not get lost in the system and they will ‘feel’ that they are in control of their own learning.

Perhaps the most important element of the model is the implementation tool used to develop the system. It is interesting to note that perhaps this is one of the few coursewares in the world and perhaps the only one in the country that is designed and implemented without the use of any implementation tool but relied totally on the use of the object oriented programming language: **JAVA**. This means that this multimedia based tutoring system is internet ready and can be shared by other school children around the world round the clock.

### 4.2 Modules Developed in the Model for ME

Figure 1.2 shows the details of the modules built into the model of this multimedia based tutoring system. As one can observe from the model, the main modules developed are based on the student learning approaches such as: **Pengukuan** or Reinforcement, **Ulangkaji** or Revision (though some might categorize this module as **Pemulihan** or remedial - but the researchers felt that this might demotivate learners using the system and thus preferred the term ulangkaji which gives a more positive connotation) and **Pengayaan** or Enrichment module. The researchers termed this as the **PUP** approach.

The **Pengukuan** module is develop based on the basic assumption that the ‘smart schools’ to be set up in the country will have to take place in stages or phases. With this module, the smart schools can use it immediately as it is suitable for the first phase where teachers still play an important role. The assumption made here is that teachers teach the topics first and this system then helps teachers to reinforce their teaching.
Learners can then reinforce their learning by undertaking the exercises prepared in this module. They can work on this module at their own pace by repeating the exercises as allowed by the system. Teachers then play the role of facilitators. This module consists of three basic components namely: Induksi or Induction, Perkembangan or Development and Latihan or Practice. Induksi involves the approach used in the introduction of the topic with the objective to attain the attention or interest of the learner to the topic introduced. In this package the induction used is the video clips and dialogue of the children based on the theme chosen. Perkembangan involves the examples or steps shown on how to solve certain mathematical problems. Latihan or Practice involves monitoring students’ performance based on the exercises set by the system.

The Ulangkaji or Revision module enables learners weak in certain topics to relearn the topic until they understand. The students are allowed to repeat this module for as long as they want without any embarrassment until they feel they have finally understood and ready to go to a new topic in the Pengukuhan module. This module consists of three components namely: Penerangan or Explanatory, Meneroka or Exploratory and Aplikasi or Application. The researchers termed this the PMA approach. The ulangkaji module is built with the basic assumption that students are not able to follow the teacher’s teaching the first time in the class, and thus the system will need to give the best possible approach so that students can understand the topic and able to do the related exercises after undergoing this module. Thus the penerangan component forms the most important component in this module as it involves explanation in the most comprehensive way so that the student understand the topic better. This component normally involves detailed steps and examples on the topics taught. The approach undertaken in this component is different from the approach undertaken in the
Pengukuhan module. The Meneroka component is interesting because it takes into account the curiosity and exploratory nature that exists in all humans which is particularly strong in young learners and needs to be catered and nurtured to stimulate thinking skills. The third component is Aplikasi. This component helps learners to apply the mathematical concepts taught in last two components of this module. This component adopts the problem solving approach which again encourages the development of thinking skills in learners.

The Pengayaan module is built into the system with the objective of providing enrichment learning materials for the students who have completed all the topics or units in the Pengukuhan module without any problems. The materials in this module may also be suitable for gifted learners as the problems in this module requires learners to think, make analysis and apply the concepts learnt earlier. This module comprises two components namely: Meneroka and Aplikasi. The researchers termed this the MA approach. The former, like the exploratory component in the Ulangkaji module, allows the student to explore, ‘experiment’ and discover the learning himself. In both the modules this exploratory component enables the student to communicate with the system interactively and the student has to be actively involved in the learning. The latter, like the application component in the ulangkaji module allows the student to apply their knowledge on the concept to solve the problems posed. However, the problems posed in this module is more complex than that posed in the ulangkaji module. It is worthwhile to note that like the exploratory component, this application component encourages to stimulate thinking skills and forces the student to be an active learner with the system.

The other module of ME as indicated in the model is what the researchers termed as the Pengurusan Pengajaran Guru (Teacher Management Instruction) or PPG module. This component is to comprise such components as : a database of students’ records, students’ overall achievement using the system, students’ performance in individual topics or units of the program, and the overall performance analysis of all students in the class. This is certainly an important element in the model for teachers because teachers can monitor students’ performance more systematically and this will enable teachers to act upon early intervention to help overcome students’ mathematical problems. This dynamic teaching methodology will probably overcome students’ dislike for the subject unlike the traditional teaching which detects students weakness in the subject too late.

The other module in the model that needs mention is the Ujian or Test module. This module is intended to be built into the system with the objective of testing the students on their overall understanding of the topics or units taught in the package. Teachers can thus monitor students’ performance or achievement based on the exercises in the PUP modules as well as in this Ujian module. All the records of scores obtained by the students wherever they may be can be collected, stored and retrieved by the teachers anytime through the PPG module mentioned earlier.

4.3 Flow of Modules of ME

Based on the present prototype, the flow of the various modules as indicated in the conceptual model of ME can be observed in Figure 1.3. As can be observed from the Flow diagram, the learner can choose to begin on any topic or unit. But as soon as he or she has ‘successfully’ or ‘unsuccessfully’ completed the unit he or she is on, the system will direct the student to the next appropriate module: either to the Pengayaan or the Ulangkaji module respectively. Once the student is in either module, he or she will have to follow the
components in the modules respectively. However, when he or she has finished the ‘proper cycle’, the student is then free to choose a new topic or unit. This means only a first time user will use the system linearly, otherwise they can use the system in a non-linear manner. There are interactive activities within the modules.

5. Further Enhancement On The Dynamic Courseware : Me

This R&D project is expected to continue for the next two to three years. The present prototype covers the whole syllabus of mathematics for standard one. Presently, as far as the interface is concerned one can say that some of the components are catered for in this package. If one were to examine the component: user friendliness of the system based on a specification document guidelines produced by the Committee on Specification of Courseware initiated by MIMOS, UKM and MOE (1997), it can be concluded that for this particular component, the system is at the medium or intermediate level of effectiveness. This inference is made based on the following characteristics or indicators already existed in the system such as: the interface uses graphics for most of its icons; the instructions to the mathematical problems can be heard if the learner have difficulty in reading by clicking the ‘sound’ icon; computer jargons are used at a minimum; the courseware has included a ‘help’ icon for users who faces problems when using the system. Thus, further enhancement is expected to occur to make it really user friendly or as deemed by the committee at a high level of effectiveness. Again, if one were to examine the level of interactivity of the courseware based on the specification document, one can conclude that it is presently at the medium or intermediate level of interactivity. This inference is made based on the following characteristics or indicators of this component in the system as follows: student to a certain extent can control and explore knowledge from the courseware; the courseware uses a dynamic metaphor of presentation of knowledge; widgets used are creative and meaningful; presentation of the topics are not sequential, although branching is minimal; tracking to be done is still minimal; and student control pace of learning. Thus, there is still room for further improvement in this respect to enhance it at the high level of interactivity.

Still on the aspect of interface, the component on fun in this courseware can be said to be at the intermediate level although a number of indicators from the high level indicator is presently available in the prototype. Based on the specification document, the indicators for medium or intermediate level are: the integration of various media; animation must be part of the media available; use of gaming approach in presenting problems; use of indirect learning approach or thematic approach (these are the medium level indicators available in the prototype) and the indicators of the high level presently available in the prototype are: learning is presented using the adventure approach; and problems are presented in the exploratory and application approach. There are other indicators that need to be fulfilled and thus this means that there is still room for further improvement in this respect. Reinforcement is part of interface and on this aspect, based on the specification document, this component is at the medium or intermediate level. This inference is made based on the characteristics or indicators presently available in the prototype such as: voice giving positive reinforcement like ‘syabas’, ‘tahniah’, ‘bagus’, ‘cuba lagi’, and ‘jangan putus asa, cuba lagi’; reinforcement is further supported by a graphics and animation indicating a right or a wrong answer; student has a choice to hear the voice or otherwise.

Another component in the aspect of interface is the navigation approach. Based on the specification document, the prototype has a navigational approach that is presently at the high level. This inference is based on the following indicators: the use of a dynamic metaphor
approach to navigation or ‘perpetual navigation’; the menu is the actual topics or units; the icons used do not look like komputer widgets; the main menu, subtopics or sub menus are perpetually presented on the screen; only the unique topics and subtopics which are being navigated by the learner are active (highlighted) the others remain dim and inactivated. This is to ensure that the student know where they are in the system. Although the prototype can be said to have high level navigational approach, there is still room for improvement where students can have total freedom in terms of navigation in order to be responsible for their own learning.

Various of the other aspects in the prototype like: main components of the educational courseware; learning and teaching approach component; the teacher management component; the curriculum component; the quality component; the technical component and the documentation component all need further diagnosis and improvement in order that it can be a truly multimedia based tutoring system that other future educational coursewares can emulate.

6. Conclusion

The present prototype is still at the development phase and various improvements are expected to occur in the next few months. It is important to bear in mind that JAVA is still at its early stage and thus is still unstable. However, the researchers are satisfied with its present capabilities and are confident that it is the programming language of the future and thus makes sense for the package to be implemented using JAVA. Although ME have not been tested empirically, based on observations and studies made on available educational coursewares in the market, ME can be said to have some strengths above these coursewares and some of these strengths can be detailed out as follows:

The system adopts the indirect method to learning mathematics based on the thematic approach and to make it more meaningful to the students, the national park in Pahang is used as the adventurous exploratory theme to present the mathematical concepts and problems; the courseware has incorporated interesting and colourful graphics as well as animation to enhance students’ interest on the lessons taught; the system adopts the perpetual navigational approach which helps students use the system more effectively as they are constantly aware where they are in the program; the system is user friendly and is thus easy to use; the use of children’s dialogue in the courseware makes the child feel at ease and is motivated to continue running the program; the interactive approach of the system ensures that the student in actively participating in the learning process; the interactive approach to the exercises also means that students are able to obtain feedback from the system as to whether they are correct or otherwise, immediately; the system is able to show step by step the correct method to solve a certain mathematical problem if he or she goes through the ‘ulangkaji’ module and this can be repeated many times until the topic is fully understood; the modules: PUP is unique to this courseware and this caters for all levels of students (the average, slow and gifted learners); the components in the modules: PMA and MA is also unique to this system and encourages thinking skills in the students; the courseware can be categorized as a dynamic courseware; and the implementation is done using JAVA which enables the courseware to be placed in the internet for a large audience around the globe.
This multimedia based tutorial package is the first courseware development experience for the researchers in so far as using JAVA is concerned and it is hoped that this tutoring model for the teaching and learning of Mathematics when tested empirically amongst school children will prove to be beneficial to both teachers and students alike and will serve as the framework for future development of multimedia based tutoring system.
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