A Study on the Types of Interactivity and their Functions in Two Language Instructional Softwares

by

Chin Fuan Hong
Tuanku Bainun Teachers' College, Malaysia
xjchin@pl.jaring.my

ABSTRACT

This study aimed at categorizing the types of interactivity found in two GSCE English learning softwares and interpreting their functions. The primary focus was on exploring the instructional events executable and the levels of cognition attainable by each type of activity. Pedagogical implications behind each type of interactivity were made, to show that what appeared was not something coincidental, but had been based on some strong theoretical foundation. The qualitative study conducted undoubtedly positioned the researcher as the instrument of measurement, but every effort had been made to render the pedagogical implications drawn as objective as possible, based on relevant established instructional theories. Likewise the naming of the types of interactivity was kept to the repertoire of authoring or web design terminology currently in use, like "clicking the button", "drag and drop", "text entry" and so on. The study concluded that each type of interactivity carried certain pedagogical significance, and could be interpreted based on the perspectives of behaviorism, cognitivism and constructivism, such as learner's control, self-paced learning, mastery learning, learner's engagement and higher order thinking processes.

INTRODUCTION

Background of the Study

In recent years, there has been spectacular and overwhelming development and progress in information technology and programming techniques. Its massive impact is remarkably discernible in the field of education. Expectedly instructional packages in the electronic form have also gained more and more sophistication, in the form of compact discs, or distributed via internet and intranet.

To a certain extent, instructional programmes that have flooded the market of educational resources bear testimony to how advanced programming technology has been. As a result, it is not a formidable task nowadays to produce something that departs from the traditional mode of knowledge dissemination in the form of one-way direct transfer such as the printed media. Many of these programmes are conveyed through audio, graphic, visual, and even video forms with animation.

Apparently in cases where highly abstract contents are involved, as for instance in philosophical discourse or in very high level intellectual activities, the imparting of

knowledge in the form of electronic texts is deemed functionally adequate, if not the most ideal for its freedom from multimedia disturbances. However, in most computer-based learning, the use of multimedia is regarded as a more stimulating and interesting form of learning, more vivid and engaging.

A common fallacy is the assumption that whatever that exists in the multimedia form must be stimulating and captivating – what is termed as "motivational complacency" (Spitzer, D.R. 1996). Perhaps what was expressed by Clark(1983) two decades ago sounds exaggerating, but his comment should serve as a reminder for instructional programme designers:

> "The best current evidence is that media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition."

Likewise O'Neil (1995) twelve years after Clark came up with the following comment:

> "The graveyard of school reform is littered with technological innovations that failed to live up to their advance billing."

In connection with this issue, it is not uncommon for students to complain of the lack of efficacy of certain instructional packages owing to the lack of interactivity or the stereotyped nature of the interactivity which occurs in the form of repeated and boring patterns.

Statement of the Problem

A study on some instructional software programmes clearly indicate that many instructional programme softwares have a tendency towards certain types of interactivity. The general impression is that such repetition may make learning a drudgery and consequently may adversely affect the level of motivation among learners.

This phenomenon is aggravated by the use of interactivity which has formed a cliché in many CAI environments of the past, that is interactivity which merely calls for such a simple response as "yes" or "no", followed by a stereotyped feedback either "your answer is right" or "wrong, try again". This is exacerbated by prolonged use of the same type of interactivity when too many response items have been given in a particular learning session owing to the designer's zestful adherence to the principle that "Practice makes perfect".

On the other hand, as a defense mechanism against the accusation of lack of functional interactivity and reducing computer-based learning to reading of mere electronic text, there has arisen the other extreme – too much interactivity or interactivity overloading. Abuse of interactivity, be it too excessive or decorative, may distract students' attention from the primary aims of instruction. It is not uncommon that in certain interactive game, the energy and time consumed by a learner to comprehend and put to use the rules of the game may not even be made up enough by the knowledge gained from the comparatively easy stimuli presented as the primary focus of learning.

PURPOSE OF THE STUDY

This study aimed at categorizing the types of interactivity found in two GSCE English learning softwares and their functions. The primary focus was on exploring the instructional events executable and the levels of cognition attainable by each type of activity. This study aimed at answering the following questions:

(1) What were the types of interactivity commonly found in instructional software?
(2) Could particular functions be attached to certain types of interactivity?
(3) Could higher order thinking skills be achieved through the use of particular types of interactivity?
(4) What were the pedagogical implications which could be drawn from each type of interactivity?

REVIEW OF RELATED LITERATURE

The theoretical framework which forms the foundation of the study includes the following components which are considered of relevance: concepts of interactivity, related learning theories, concepts of higher order thinking and instructional principles.

Concepts of Interactivity in Multimedia Learning

Many definitions have emerged, some instance of which are as follows:

- the ability to react to words, numbers and pictures (Kristof & Satran, 1995, p.1)
- the ability to gain access to and manipulate texts, sound and images (Ambron & Hooper, 1988, p. xi)
- reciprocal mutual exchange between the learner and the instructional media (Reynolds & Iwinski, 1991, p.581)
- a design concept which incurs a true exchange of information between the user and the programme (Gayeski, 1995, pp. -)

Perhaps the definition by Driscoll, M. (1988) includes all the salient elements:

> "the ability to provide control, to direct attention, and to coordinate the communication among the students, instructor and content"

According to this definition, interactivity involves the ability of the learner to control his own learning, to direct attention and to interact, either between the learner and the learning material, among students or between the learner and the instructor through the multimedia material.

Many theories have emerged as to what is meant by efficient learners. One of the striking elements is "self-regulation" or the students' ability to participate actively in their learning. The capacity to control one's motivation and behaviour, as reiterated in the social cognitive theory brought forth by Bandura (1977, 1986) has been acknowledged as one that should be owned by an active learner engaging in the process of learning. This concept has become the premise for the enormous efforts to make multimedia learning as interactive as possible.

The significance of turning multimedia learning into an interactive process has been much discussed. Although attention in this respect has very often focused on learning via the Internet, observation noted by El-Tigi and Branch (1997) is worth pondering upon. According to El-Tigi and Branch, many web-pages designed for instruction and learning lack interaction, learner control and feedback. In other words, these web pages have not been designed to promote active learning, but merely aim at transmitting knowledge in a one-way communication format, as is normally found in a normal academic text. Consequently a technology with enormous potentialities has degenerated into a passive learning tool.

Related Learning Theories

Cognitive Theories

In order to design an effective learning package, awareness of how information is registered and processed is an asset. Of enormous help is the information processing theory. Atkinson and Shiffrin (1968) put forward a model which has served to illuminate how a piece of data that has been perceived and registered by the sensory registry can be processed and rehearsed in the working memory until it can be turned into that of the long-term memory (Figure 1). The model is of significance to instructional designers in its emphasis on rehearsal. It implies that under normal circumstances for any instruction to be effective, there should be enough rehearsal to ensure the transfer of information to the storage of long-term memory. According to Rumelhart and Ortony (1977), knowledge is stored and retrieved in bundles or packets called data schemata or state schemata. They also hold that there are procedures or ways of processing and organizing information known as process schemata. The process schemata function in such a way as to direct perception. Perception is thus defined as active, constructive, selective and schema driven. Many events occur simultaneously and we perceive some portion of these events in a selective manner based on an attendant schema. In other words the event is constructed in terms of our schema.

Cognitive Strategies

Knowledge of cognitive strategies may help to comprehend the significance behind certain patterns of knowledge presentation procedure in instructional softwares. It is very likely that these instructional units may employ several cognitive strategies. West, Farmer & Wolff (1991) have categorized the strategies under four families, chunking, bridging, spatial and multipurpose. In managing an overwhelming amount of data, a designer has to employ some organizing strategies in order to process and present the data according to certain rational classification or arrangement. Prior to the presentation of new material, there may be a brief outline of what is expected to come and this incurs the use of bridging strategy or an advance organizer. It may incur the use of spatial strategy in terms of concept maps. In order to help learners remember something, mnemonics or artificial aids to memory may be employed.

Constructivism

Constructivism holds that learners actively construct their own knowledge (Dick, W. 1991). Constructivists generally prefer contextualized learning and integrated testing.

There should be active participation on the part of the learners as they plan and control their learning and practice experiences and finally apply the skills to differing examples.

In seeking the element of constructivism in an instructional unit, one may find it of help to refer to Papert's distinction between instructionism and constructivism. According to Papert (1990), instructionism is a dominant mode of learning in schools. According to this perspective, students are passive receivers of information and knowledge from teachers. The students' principal aim is to receive and accumulate knowledge and to reproduce it in examinations. On the other hand, constructivism focuses on the process of how we build up or construct our knowledge. Knowledge which we construct depends on what we have already known, our experience and how we interpret that experience in the context of reality, which exists in the mind of each individual. Hence a teacher just simply cannot map his own interpretation of knowledge and experience directly on to a student's mind. It follows that knowledge is a process of negotiating sense, not that of transmitting directly a matured reality. According to the process of constructivist learning, a learner has to react with his learning environment to arrive at his own perception about a subject.

Hypermedia/multimedia as a tutor or teacher bears a contrast to its role as a tool of construction, as stated by Salomon, Perkins and Globerson (1989). The former refers to the effects of multimedia, as if the learners did not contribute any input to the process. Conversely in the latter, effects with computer technology are said to be in operation, in which the learners enter into an intellectual partnership with the technology. In this context, learning with hypermedia/multimedia incurs mindful engagement in the tasks assigned by the tools.

Gagne's Nine Instructional Events

Normally interactive interfaces perform certain functions, such as presenting further information or stimuli, assessing performance or providing feedback. In order to ensure a relatively exhaustive list of functions of interactivity, Gagne's nine instructional events constitute a clear frame of reference:

(i) Gaining attention
(ii) Informing learner of lesson objective
(iii) Stimulating recall of prior learning
(iv) Presenting stimuli with distinctive features
(v) Guiding learning
(vi) Eliciting performance
(vii) Providing informative feedback
(viii) Assessing performance
(ix) Enhancing retention and learning transfer

Higher Order Thinking Skills

In view of the complexity of the discourse about higher order thinking skills, which in fact include metacognitive skills, this study would still largely refer to Bloom's taxonomy (1956) as the basis for the categorization of thinking skills into both lower and higher order groups. Broadly speaking, questions which incur mere recall of knowledge or which test fundamental understanding are considered belonging to the category of lower order thinking skills. Those that involve application of principles in problem-

solving, analysis to determine part-whole relationship or patterns, synthesis to make hypotheses or draw conclusions, or evaluation to judge the strength of something or to determine the credibility of a source are regarded as belong to skills of the higher category.

In relation to higher-order thinking skills in cyber learning, Vockell, E & van Duesen, R.M. (1989) include such skills as metacognition, critical and creative thinking, those of classification, analysis and synthesis, as well as reasoning at a conceptual level rather than by rote memorization.

Definition of Terms

The terms used in this study are defined as follows:

Authoring
Employing an authoring language or system to design and develop instruction

Higher order thinking processes
The manipulation of information or solutions through the processes of analyisis, synthesis, application and evaluation

Interactivity
According to Driscoll, M. (1988), interactivity is the ability to provide control, to direct attention, and to coordinate the communication among the students, instructor and content. According to this definition, interactivity involves the ability of the learner to control his own learning, to direct attention and to interact, either between the learner and the learning material, among students or between the learner and the instructor through the multimedia material. In this study interactivity incurs the following processes: a stimulus (e.g. a navigating button) prompts a learner's action (e.g. drag and drop) which in turn triggers off a learning process.

Mastery Learning
A systematic learning mode which is based on students performing to a pre-determined criterion level on a given unit of instruction before proceeding to the next unit of instruction. (Dick and Carey, 1990).

METHOD

Design of the Study

Based on the availability of instructional packages comprehensive enough for the purpose of the study, only two packages were selected for this study. The qualitative approach was adopted so that phenomena of events related to the purpose of the study were observed, recorded and interpreted.

Sample of the Study

The sample comprised two GCSE (General Certificate of School Examinations) English learning packages produced overseas. They were selected in view of their availability in the market and their adequacy in contents for the study.

Instrument of the Study

To name the types of interactivity and categorise them, the repertoire of authoring or web design terminology currently is use was referred to, such as those used in Macromedia Flash and Dreamweaver. Examples of such terms are “clicking the button”, “drag and drop”, “text entry” and so on.

Gagne’s nine events of instruction were used to interpret the instructional event brought forth once the learner responses to an invitation to interact by clicking on a button, having a drag-and-drop, or doing a text entry.

To examine the extent of cognition enabled by a type of activity, Bloom’s taxonomy was used. Apart from that focus on higher order thinking skills was a more important concern here.

The three perspectives of behaviourism, cognitivism and constructivism were also employed as a premise of interpretation.

Data Collection

The two instructional packages were examined frame by frame. Frames showing buttons or bars of interactivity were recorded and printed out for reference. The ensuing event triggered off by a particular action (click, drag and drop, text entry, as for example) was also recorded and printed out for interpretation.

Data Analysis

Each recorded event was interpreted so that each type of interactivity could be categorized for functional analysis.

What type of interactivity was enabled by a particular action was then studied and rendered in descriptive form. Further interpretation was carried out based on the level of cognition. Pedagogical implications were drawn based on Cagne’s events of instruction, cognitive theories of learning and Bloom’s taxonomy of cognitive levels as well as criteria of higher-order thinking skills.

FINDINGS AND DISCUSSIONS

The following types of interactivity were identified and the functions of each, which include pedagogical considerations were interpreted.

1. Clicking the button

Both instructional packages had their menus displayed with navigational buttons showing the various topics included. A click on the topic would lead the learner to the area concerned. Figure 2 is an example.

The functions of such buttons carried such effects like “Go to and Play”, “Return to Menu”, “Next/Forwards” and “Back/Backwards”.

In one of the programmes, it enabled choice of level on the part of the learner. Figure 3 is an example.

A click on a button may reveal something new, spectacular or exciting. For instance, in order to accentuate the contrast between a less effective use of adjectives and a much more powerful one, a click on a button may enable a comparison and contrast to take place, or revealing a sharp contrast between a short passage with vague adjectives and that with more specific adjectives, which produced a sharper or more vivid picture.

Pedagogical Implication:

To a certain degree, this function enables learner’s control. The learner can decide at any point whether to proceed, to move backward, or to pause.

Another important function of this type of button was to check feedback for a certain response to a stimulus, which could be in an exercise, a pre-test, quiz, or post-test.

This function normally is thought of largely falling within the behaviorist perspective, with its principal one of “drill and practice”. However, while in the form of quiz it necessarily shares the shortcomings which objective tests suffer, the technology available makes immediate reinforcement or feedback much prompter and dynamic than that of the ordinary textual form. Questions, like those in textual form, may range from low to high order thinking skills, though it is true that the higher we go, the more difficult it is to fulfill the task.

The clicking of a button for definition, illustration, further detailed information or guidance (as found in the section known as “teaching point” in one of the packages) enabled the learner to gain access to information on his own accord.

One of the implications is that self-access learning is made possible, particularly with hyperlinks assiduously designed.

This action also might trigger a rightly-chosen answer fly towards its appropriate target or cause a wrongly-chosen one to remain at its original position. This action (which substitutes the drag-and-drop action) was rendered possible with the progress in authoring tools.

This type of interactivity may serve to raise the cognitive level to that it may transcend the behaviorist perspective and enter the realm of cognitivism. As for example, it may incur the ability to differentiate the different implications of two sentences in order to decide which is the more appropriate response.

A higher level of cognition is enabled – the ability to compare and contrast. It involves analytical skill to discern the difference between what is appropriate and what is not, or to identify and select relevant items from a given list

Clicking upon certain phrases to fade out specified items, or irrelevant/incorrect ones, could be found in one of the packages. Figures 4(a) and 4(b) provide a good example.

2. Click and Drag

Filling in the gaps/blanks of sentences by clicking and dragging appropriate words was the most common activity. Immediate feedback was given to a response, either in the form of a tick showing the correct answer or a cross indicating an incorrect one. Specimen 6 is an example.

Pedagogical Implication:

Click and drag activity saves the learner's time as he just has to move his cursor instead of typing out words to fill in the blanks. The level of cognition may range from a mere test of knowledge or basic understanding to a more challenging test on analytical or integrative skills. A test on choice of words bearing almost similar meanings to fill in the blanks of sentences can be much more challenging than that involving words with vastly different meanings.

Clicking, dragging and dropping phrases or sentences into appropriate columns or boxes was yet another activity. For instance, the learner was asked to click, drag and drop statements for and against the title "Every Home Needs a Computer" into the appropriate columns.

Pedagogical Implication

This type of interactivity opens up opportunity to test the learner's cognitive skills of analysis (breaking apart ideas), integration (putting together ideas to form a harmonious or organized unit) and even evaluation (forming value judgement). For instance the learner can be asked to click, drag and drop sentences into pre-set boxes according to a rational order to produce a well-organized short essay. He can be asked to drag and drop emotive/biased statements into one column and objective/unbiased statements into another.

3. Text Entry with Feedback

The user input a response by typing letters in a text block and received immediate feedback. For instance, the learner was shown a word for a second and upon the fading of the word, asked to type out the word in the text block provided to check his ability to spell it correctly.

Pedagogical Implication:

While the above example seems to be quite mechanical, this type of interactivity in fact can be elevated far beyond the behaviorist perspective. For example, the learner can be asked to type in an apt adjective to describe a splendid sunset – a word with the first letter

"g". One of its merits is that a hint or cue can be given to activate learner's thinking along the right track.

4. Integrative Interactivity

With the combination of a few types of interactivity, one of the packages offered a problem-solving activity in the form of a "deadline"game. In this game, the user was allotted a specified time to do some editing work on an article to be published by the press. He had to find out errors in punctuation, grammar and the spelling of certain words. When the time was up, his performance was assessed.

Pedagogical Implication

This is a commendable effort in the exploitation of the capacity of programming tools to render interactivity more meaningful and effective. This presents a more realistic learning environment and a more authentic problem-solving case which serves to augment meaning in learning. By combining a few types of interactivity, it is possible to present authentic tasks and provide real-world, case-based learning environments – a feature which is given much stress in the constructivist theory of learning.

CONCLUSIONS

This study essentially was both descriptive and interpretative. It aimed at interpreting beyond what was visually perceivable. Based on the interpretation thus far, several conclusion could be drawn.

Limitations of the study

Since the study aims at examining types of interactivity, the focus is more on clickable bars and buttons and the activities initiated by the clicking. It is restricted to the study of CD-ROM softwares. Wider scope of interactivity as enabled through the internet such as in the form of teleconferencing and e-mail is outside the scope of the study. Also the study is merely based on two instructional English learning softwares in the market.
Another limitation is that since this is a qualitative study, interpretations and generalizations made are based primarily on personal perception.

Implications of the study

A well-designed electronic learning package should able to create interactive learning environments, which, according to Wilson (199),

> "allow for the electronically integrated display and user control of a variety of media formats."

For any functional interactivity, there must be behind it significance which can be interpreted on a theoretical premise. For instance, a menu made up of buttons/bars with each indicating a topic normally comprises less than 10 topics to avoid a sense of data overloading. Navigating buttons allowing freedom to move forward or backward or to quit is in line with the concept of learners' control.

The two psychological perspectives – behaviorist, cognitivist and constructivist have to be duly considered in designing a quality language learning software. It all depends on the pedagogical and psychological principles which govern the design and to what extent efforts have been made to render the software as meaningfully interactive as possible. For instance the level of learner's engagement can be enhanced by having meaningful and varied forms of interactivity. Tasks should be geared to learner's level to ensure they are worth learning and immediate feedback to every response will help to sustain interest.

Pressing the button as a response to a stimulus sometimes cannot be viewed as a mere drill and practice activity as advocated in the behaviorist perspectives. Sometimes a clicking or drag-and-drop action to give response involves the utilization of higher order thinking skills, as for instance rearranging sentences to form a paragraph or a coherent piece according to a time sequence.

Through self-paced meaningful learning, interactivity and feedback on response, the level of learner's engagement can be raised, as he will invest more effort in learning the task.

In our current emphasis on the cognitivist and constructivist perspectives, we tend to neglect the role played by the drill and practice mode of the behaviorist perspective. According to Heinich, et al. (1993) drill-and-practice is used commonly for such tasks as studying math facts, learning a foreign language, and building a vocabulary.

An eclectic approach is recommended in order to design a learning package which is more adaptable to meet instructional objectives.

In the final analysis, it is the designer's awareness of the strengths and constraints of instructional software and his ability to utilise fully the tools of interactivity to meet his pedagogical ends and psychological perspectives that help to enhance the effectiveness of his package.

Suggestions for Further Research

The efficacy of self-tutoring packages in the form of CD has long been questioned, particularly in their capacity for constructivism. Further research in the area, particularly in the analysis of specimens with elements of constructivism and higher order thinking skills may serve to shed more light in the realm of instructional design.

REFERENCES

Atkinson, R., & Shiffrin, R. (1968). Human memory: A proposed sistem and its control processes. In K Spence & J Spence (Eds.). *The psychology of learning and motivation: Advances in research and theory* (Vol.2). New York: Academic Press.

Ambron, S & Hooper, K. (1988). *Interactive multimedia: Visions of multimedia for developers, educators, and information providers*. New York: Cobb Group.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 8(), 191-15.

Bloom, B.S. (1956). *Taxonomy of educational objectives: Cognitive Domain.* New York, Longman.

Cagne, R.M. (1985). *The Conditions of Learning and Theory of Instruction*. New York: Holt, Rinehart & Winston.

Clark, R.E. (1983). Reconsidering research on learning from media. *Review of Educational Research*, 53().

Dick, W. and Carey, L. (1990) *The Systematic design of instruction.* Glenview, IL: Prentice Hall.

Dick, W. (1991). An Instructional Designer's View of Construction. *Educational Technology* 31(5), 1- (1991).

El-Tigi, M., & Branch, R.M. (1997). Designing for interaction, learner control, and feedback during web-based learning. *Educational Technology*, 37(3), 3-9.

Gayeski, D.M. (1995). *Interactive media.* Englewood Cliffs, NJ: Prentice-Hall.

Heinich, Molenda, Russell, & Smaldino. (1993). *Instructional Media and Technologies for Learning*. Prentice Hall, NJ.

Kristof, R. & Saatran, A. (1995). *Interactivity by design: Creating and communicating with new media*. Indianapolis, IN: Hayden Books.

O'Neil, J. (1995). On Technology and schools. *Educational Leadership*, October.

Reynolds, A. & Iwinki, T. (1966). *Multimedia training: Developing technology-based systems*, New York: McGraw-Hill.

Rumelhart, D.E. & Artony (1977). The representation of knowledge in memory. In R.C. Anderson, R. J. Spiro, & W.E. Montague (Eds.). *Schooling and the acquisition of knowledge.* Hillside, NJ: Lawrence Erbaum Associates.

Salomon, G. Perkins, D.N., & Globerson, T. (1989). Patterns in cognition: Extending human intelligence with intelligent technologies. *Educational Researcher*.

Spitzer, D.R. (1996). Motivation: the neglected factor in instructional design. *Educational Technology*, May-June.

Vockell, E. & van Duesen, R.M. (1989). *The Computer and higher-order thinking skills*. Watsonville, CA: Mitchell Publishing Inc.

West, C.K., Farmer, J.A. & Wolff, P.M. (1991) *Instructional Design – Implications from Cognitive Science*, Prentice Hall, New Jersey.

Wilson, K. (199). Discussionon two multimedia R & D projects: The Plaenque Project and the Interactive Video Project of the Museum Education Consortium. In M. Giardina (Ed.), *Interactive Multimedia Learning Environments* (pp. 186-196). Berlin: Springer-Verlag.

Appendix

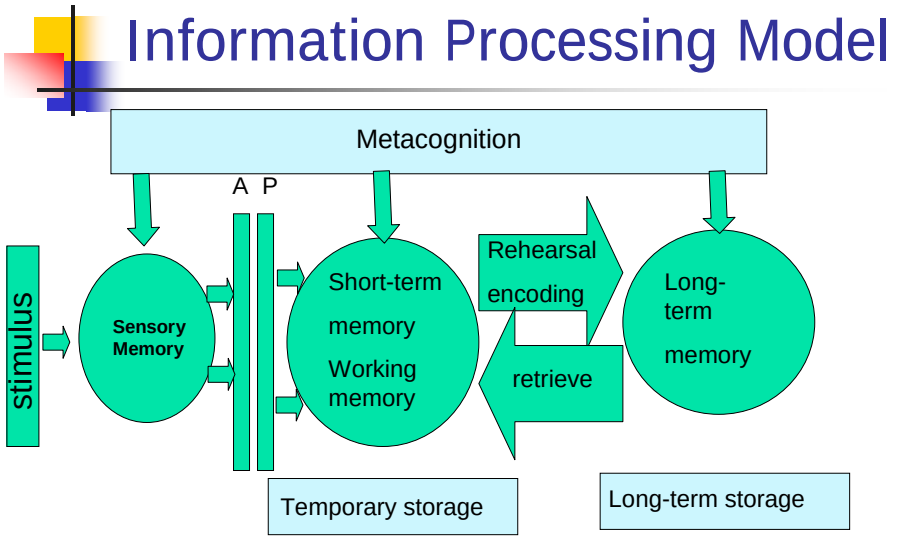

Figure 1

Figure 2: Menu

Tier Selection

When you select the level, or tier, that you require, you will only see exam questions which are appropriate to your tier.

If you decide to change tier while you are running the program, click on **File** on the menu bar, then click on **New**.

Figure 3 : Tier Selection

Figure 4(a) : Before Clicking

Figure 4 (b) After Clicking