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USE OF MNEMONIC METHODOLOGY FOR TEACHING TECHNICAL CONTENT IN OBJECT ORIENTED PROGRAMMING

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"If a student can't learn the way we teach, may be we teach the way they learn" –Ignacio Estrada

Abstract
No two teachers are alike, every teacher has their own unique style of teaching, which helps students in the learning process and helps them to develop critical thinking skills. Understanding the need of student, as a group or as individuals, is an important part of good teaching. Since the time immemorial, different teaching methodologies were used to educate students. This paper presents the overview of mnemonic methodology and its usage for teaching technical content in Object Oriented Programming. Emphasis is placed on creating different concepts of object oriented programming using mnemonics technique.

Keywords: Teaching Methodology, Techniques, Styles, Mnemonics, Linguistic Mnemonics, Spatial Mnemonics, Verbal Mnemonics, Visual Mnemonics, Physical Mnemonics

1. INTRODUCTION

In search of way, to use different teaching methodologies for teaching technical content, I have turned to a practical approach to develop and implement Mnemonics methodology for different concepts used in object oriented programming. This paper first outlines the goal and objective of mnemonics methodologies and then prepares the important concepts in object oriented programming using mnemonic techniques. All the technical concepts developed using mnemonics were tested over group of undergraduate students and their positive and negative responses in the form of result were added in the paper.

2. MNEMONICS: DEFINITION

The word Mnemonic is derived from Greek word Mnemosyne, referring to the ancient Greek goddess of memory. The use of Mnemonics was done back from 500 B.C. (Yates, 1966). Memory plays vital role while developing mnemonic strategies. There are two types of memories: Temporary Memory and Permanent Memory. Temporary memory is fast and keeps the information which is being processed for short time while

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permanent memory is slow and is being processed for unlimited storage capacity.
Aitchison (2002) believes that our mind is like the London Underground System, where information stored in brain is bonded in different ways some with strong bond while some with weak bond.
According to Solso (1995), mnemonics are techniques either verbal or visual in nature that serves to improve the storage of new information and the recall of information contained in memory. Mnemonics has proven to be extremely effective in helping people remembering things (Mastropieri & Scruggsm,1989 , Bulgren, Schumaker and Deshler,1994).
Thompson(1987) enlighten towards the usefulness of mnemonics by stating that they can help learners to learn faster and recall better by integration of new material into existing cognitive units and by providing retrieval clues. Mnemonics devices are useful for all ages students, however are more effective for low level students because they are involved mostly in activities requiring them to remember and recall information (Levin, 1993).

3. CLASSIFICATION OF MNEMONICS TEACHING METHODOLOGY

Mnemonics techniques are differently defined by different people. Thompson (1987) classified mnemonics techniques into five classes; linguistic mnemonics, spatial mnemonics, visual mnemonics, verbal mnemonics and physical response mnemonics. Oxford (1990) on the other hand defined four major strategies namely creating mental linkage, applying images and sounds, reviewing well and employing actions. Baddeley (1999) believes that mnemonics is classified as visual imaginary strategies and verbal imaginary strategies. This paper adopts the classification by Thompson which sounds more comprehensive.

3.1 Linguistic Mnemonics

3.1.1 Peg word Method
3.1.2 Keyword Method
3.1.3 Acronym Method

Peg words refer to set of Rhyming words that are used to stand for numbers. These are used to help students to remember information in a particular order. These words are substituted to the numbers to remember and associated with the other information. The words are learned in a composite picture of the given word and the peg (Roediger,1980, Greorger,1997, Mirhassani and Eghtesadei, 2007).
The peg words to be learned are:

One is Bun	Six is Sticks
Two is Shoe	Seven is Heaven
Three is Tree	Eight is Gate
Four is Door	Nine is Line
Five is Hive	Ten is Hen

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Figure: Peg words for remembering Numbers

For eg: In Object Oriented Programming, If the first word to be learned is Object, then its peg will be Bun. Before its meaning is defined to the students, they can formulate a mental image as Bun is an Object.

Keyword is a familiar word that sounds similar to the word or idea being taught. The teacher then creates an illustration that links prior and new information in the student's memory. The
Keyword method according to Hulstijn (1997) requires three steps. At first two words that have acoustic similarities to the target word is given to the learner to act as the keyword. In the second stage, learner is asked to make an association between the target word and the keyword. Finally, he is asked to make a mental image of the combination of the keyword and target word.

For eg: In Object Oriented Programming, Inheritance is the process by which object of one class (parent class) acquires the properties of object of another class (child class).

Step 1: Ask students to remember the words as Parent and Child as two key words and inheritance as target word.
Step 2: Now, let them make relationship among keywords and target word by delivering statement "Child inherits parent's behavior"
Step 3: It is easy for students to create a mental image for above sentence.

Acronym Method is a method where abbreviation from initial components of phrase or words is taken.
For eg: Acronym for CD-ROM is Compact Disc Read Only Memory.

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3.2 Spatial Mnemonics

3.2.1 The Loci Method
3.2.2 Spatial Grouping
3.2.3 The Finger Method

The Loci Method is actually the oldest mnemonics method, which entails imagining a very familiar places and then associating each new word with it to be remembered (Eysenck, 1994 ; Mirhassani and Eghtesadei, 2007). In other words students can take imaginary walk and retrieve the items they have to put there. As different peoples have different experiences, students may come up with different ideas (Thompson, 1987).

For eg: While teaching the concept of class in object oriented programming, "A collection of similar types of objects is known as Class." It is better to let the student imagine themselves as an objects and their class as the collection of students (objects).

Spatial Grouping is a technique, where students can write words in a structure of patterns instead of writing them in column or row. Writing words in form of patterns can help them to recall the words better (Holden, 1999). As they remember the pattern, they can remember the parts which are signed by the words.

For eg: Polymorphism is broadly classified in two parts:

1. Compile time Polymorphism and
2. Run time Polymorphism

Compile time polymorphism is further classified as Function overloading and operator overloading while Run time polymorphism is further classified as virtual function. The spatial grouping for the same is illustrated as shown below:

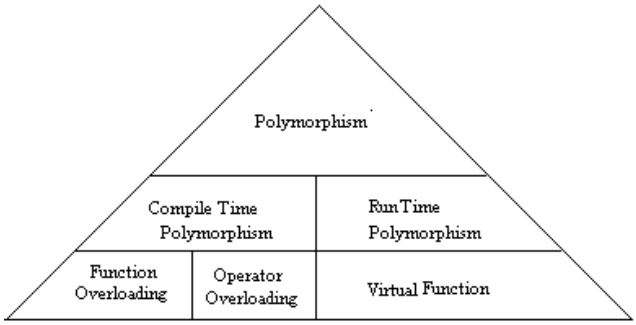

Figure: Classification of Polymorphism using spatial grouping technique.

Finger method is a method where students asked to associate each word with finger. This method is specially

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used with children to learn numbers, days of the week and month of the year (Holden, 1999).
For eg: For remembering basic concepts of Object Oriented Programming, Finger method can be implemented as:
Finger 1: Object
Finger 2: Class
Finger 3: Inheritance
Finger 4: Polymorphism
Finger 5: Abstraction
Finger 6: Encapsulation
Finger 7: Dynamic Binding
Finger 8: Message Passing

3.3 Visual Mnemonics

3.3.1 Pictures
3.3.2 Visualization or Imagery

New words are better learned if they paired with their pictures (Thompson, 1987). Gians and Redman (1986) believe that picture can facilitates and recalls. Wright (1989) also said that meaning cannot be derived only from verbal languages. Using this method, a picture can be used to make the meaning of the word clear.

For eg: In Object Oriented Programming, The word Encapsulation can be remembered with the help of picture of capsule.

Figure: Remembering Encapsulation with the help of capsule

Visualization or Imagery is used in cases where we allow a word to be visualized. The learner visualize the image which is associated with the target word. Abstract words can be learned through this method by relating them to visual picture (Holden, 1999, Thompson, 1987, Mirhassani and Eghtesadei,2007)
For ex: In an Object Oriented Programming, the concept of message passing i.e. one object can communicate with another object by sending messages to one another can be visualized as:

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Figure: Remembering the concept of message passing with the help of visualization.

3.4 The Verbal Mnemonics

3.4.1 Grouping or Semantic Organization
3.4.2 Story telling or the narrative Chain

Categorizing words in some fashion is easier to recall (Anderson, 2000; Thompson 1987). If a students are able to remember a single word, they will be able to remember the rest(Mirhassani and Eghtesadei,2007).

For eg: In an object oriented programming, the Objects like grapes, orange and mango can be categorized into class Fruit, which will be easy to remember for students.

In Story telling or the narrative chain method learner links the concept together by story. At first, he should associate the target words with topic, then he should connect them by making up the story containing the words (Thompson,1987, Holden 1999, Mirhassani and Eghtesadei,2007)

3.5 Physical Response and Sensation Mnemonics

According to physical response method, a person should move his body or part of body in such a way that illustrates the meaning of word. Thompson (1987) believes that if the information of a word or a sentence is enacted it can yield better understanding and recall.

Physical Sensation Method is defined by Oxford and Scarcella (1994). Through this method the learner associates the new word to a physical sensation.

4. PRACTICAL ASSIGNMENTS AND RESPONSES

All the technical concepts developed using mnemonics were tested over group of undergraduate students and their positive and negative responses are added here.

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4.1.1 Assignment No. 1

Objective: Defining Acronym method to remember basic concepts of object oriented programming

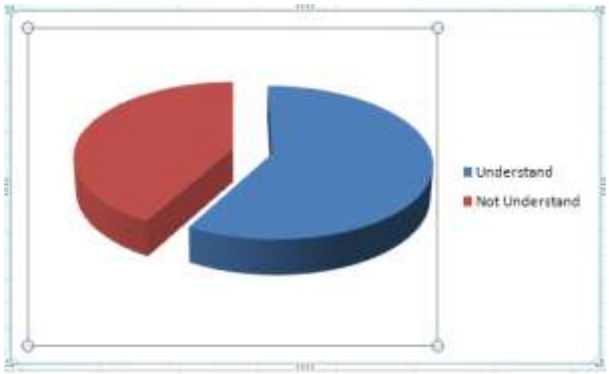
Theory: Some of the concepts used extensively in object oriented programming are:

i) Object
ii) Classes
iii) Inheritance
iv) Polymorphism
v) Dynamic Binding
vi) Encapsulation
vii) Abstraction and
viii) Message Passsing

Formulation: A group of five teams of four pax of undergraduate students were created in the class with an objective to create acronym for remembering basic concepts of object oriented technologies and the words created by them are:

Group 1: A DIM COPE
Group 2: DOME APIC
Group 3: I CODE MAP
Group 4: MEDIA COP
Group 5: A DOME PIC

Result: 64% students found the technique easy to remember while 46% student found the technique difficult to learn.



4.1.2 Assignment No. 2

Objective: Use of Grouping and semantic organization to learn Keywords, Identifiers, Constants.

Theory: Object Oriented Programming language defines the following terminologies in programming

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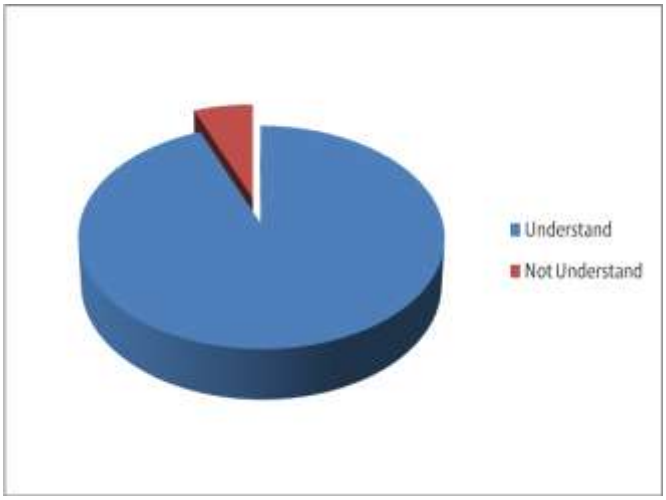
language as:
i) Keyword: Keywords are the reserved words whose meaning is already defined to the compiler.
ii) Identifiers: Identifiers are the names given to variables, functions, arrays and classes created by the user.
iii) Constants: Constants refers to fixed values that do not change during the program execution.

Formulation: All the terminologies defined above can be remembered by single word as Token which is smallest individual unit in programming domain.

Result: 94% students found the technique easy to remember while 6% student found the technique difficult to learn.



4.1.3 Assignment No. 3
Objective: Use of Visualization or Imagery technique to remember the name of Constructor and Destructor among students.

Theory: A Constructor is a special member function whose task is to initialize the object of the class. It is special because its name is similar to the class name.
A destructor is a special member function whose task is to destroy the objects that have been created by the constructor.

Formulation: To let the students remember the name of constructor an image of civil constructor from day to day life is displayed to the students, so that they can remember the name of constructor among them.

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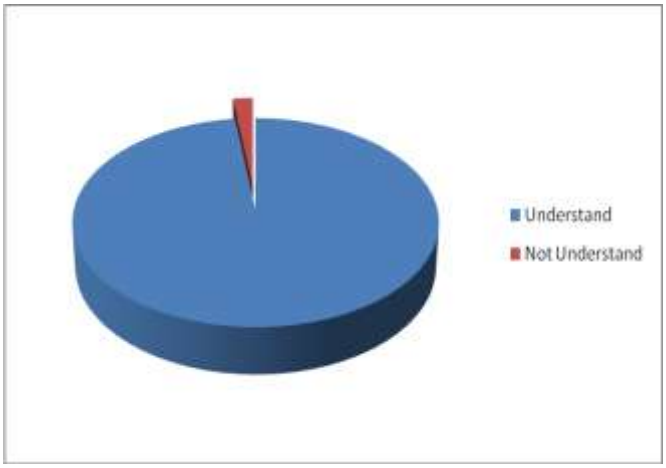
Figure: Use of Visual Mnemonic for remembering the word constructer among students.

Figure: Use of Visual Mnemonic for remembering the word Destructor among students.

Result: 98% students found the technique easy to remember, while 2% students found the technique difficult to remember.



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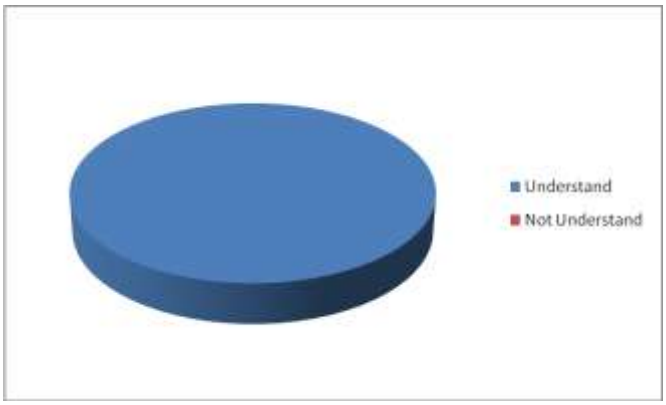
4.1.4 Assignment No. 4

Objective: Use of Story Telling or Narrative Chain Technique for understanding History of Java.

Formulation In 1991,Sun Micro system wants to develop a software to control electronic devices. This software is developed under the act of **Green Project**. An electronic device known as **Star-7**, for which an operating system has to be developed. The language they used to develop the software was C++. But one of the team member, **James Gosling**, was not comfortable with the performance of C++. Hence, he developed a new language for Star-7. He named it "**OAK**", as he used to see oak tree outside his office. The members other than James Gosling involve in the development process of OAK are **Patrik Naughton, Chris Warth, Ed Frank and Mike Sheridan**. But later they found that the name "OAK" was being used by some other language, sun renamed this language as "Java" in 1995.

Result: All students found the technique easy to remember.



4.1.5 Assignment No. 5

Objective: Use of keyword technique to introduce the concept exception among students.

Theory: Exceptions are run time anomalies or unusual conditions that a program may encounter while executing.

Formulation: A group of 18 undergraduate students were created and tested using Keyword Technique:
Step 1: The word "Error" as a keyword which is common in general life is introduced among the group. Then the word "Exception" is introduced to them.

Step 2: Now they were asked to make an association between error and exception.

Step 3: Now they were introduced with the differences among error and the exception.

Result: 97% students found the technique easy to remember, while 3% students found the technique difficult to remember.

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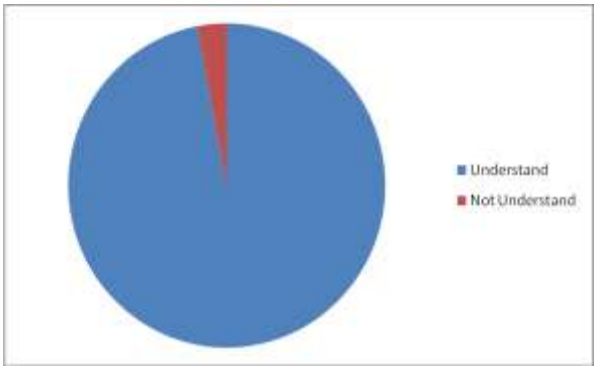

4.1.6 Assignment No. 6

Objective: Use of spatial grouping method to understand various types of inheritance.

Theory: Inheritance is the process by which object of one class acquires the properties of object of another class. The derived class inherits some or all of the traits from the base class. A derived class with only one base class is called Single Inheritance and one with several base classes is called Multiple Inheritance. On the other hand, the traits of one class may be inherited by more than one class. This process is known as Hierarchical Inheritance. The mechanism of deriving a class from another derived class is known as Multilevel Inheritance.

Formulation: A group of 18 students were tested with spatial grouping method as:

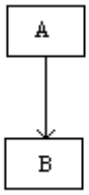

Figure: Single Inheritance through Spatial Grouping

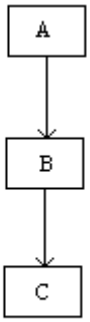

Figure: Multilevel Inheritance through Spatial Grouping

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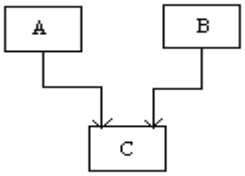


Figure: Multiple Inheritance through Spatial Grouping

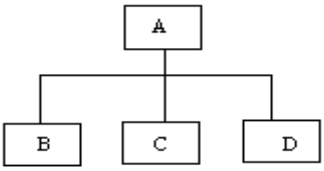


Figure: Hierarchical Inheritance through Spatial Grouping

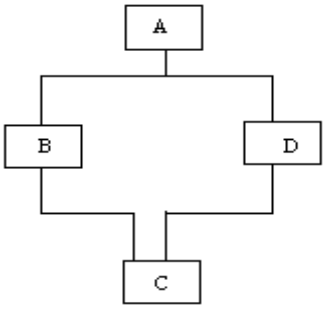
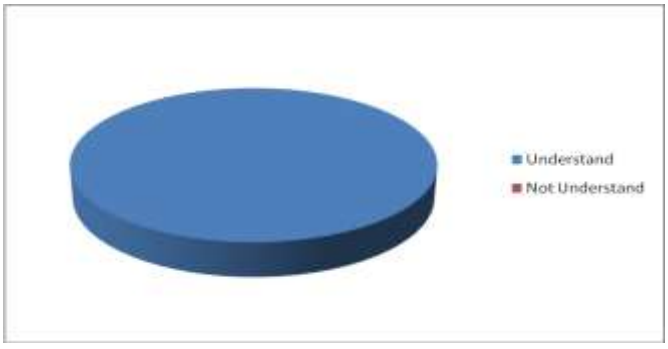


Figure: Hybrid Inheritance through Spatial Grouping

Result: 100% students found the technique easy to remember.



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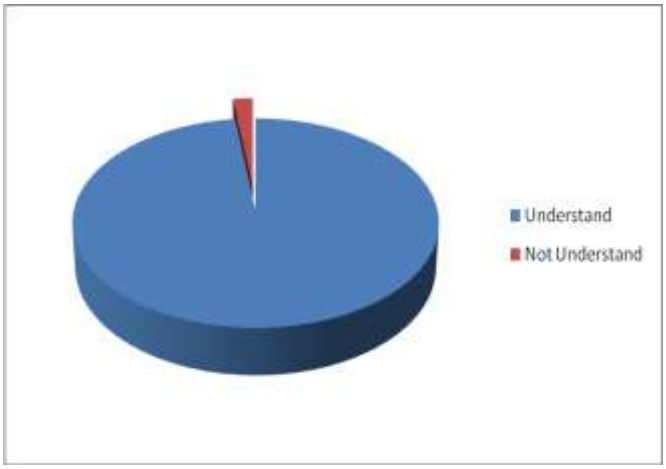
4.1.7 Assignment No. 7

Objective: Use of Loci method to understand the File not found error message.

Theory: File not found error is an error thrown when the compiler doesn't found any file path which program tries to load.

Formulation: During practical session of object oriented programming, four undergraduate students out of group of 18 students gets file not found error. To understand the reason why file not found error arise, we used Loci method, where a coordinator among all student was selected and sent to pick an alias file from bookshelf from some location say A Block 3rd floor. The coordinator returned and replied that the file is not available in mentioned location and said the File not found error occurred.

Result: 98% students found the technique easy to remember, while 2% students found the technique difficult to remember.



5. CONCLUSION

Learning computer terminologies in object oriented programming system is difficult to remember. Students always complaints that they cannot remember the terminologies used in object oriented system. To solve this problem, a number of mnemonic strategies was defined and tests were implemented on undergraduate students and their results were displayed. However, choice of adaption of strategy depends upon the students proficiency and learning style. (Coady and Huckin, 1997; Thompson 1987; Holden 1999; Mirhassani and Eghtesadi,2007).

"The best answer to the question, 'What is the most effective method of teaching? is that it depends on the goal, the student, the content and the teacher, but the next best answer is, student learn by student experience " *-Wilbert*

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