

Teaching and Learning by Object Oriented Modeling in Pre-Primary and Primary School Education



Anand S. Ghuli, Dayanand G. Savakar, Smita A. Ghuli, Pandurang H. Biradar

Abstract— Every single child in this world has every rights to be educated. It's a primary duty of the responsible parent or guardian and teacher to look after the educational process of a child. Here we propose a conceptual methodology which uses the Object Oriented Modeling (OOM) to improve the basic mode of teaching and learning process in case of pre-primary and primary school education. In this paper we propose an object oriented methodology which helps in building a new path towards formulized teaching and learning process. This process considers the child as an object and the characteristics of the objects considered are Identity, Polymorphism, Inheritance and Encapsulation. Identity means - Each child will have/exhibits its own identity. Polymorphism – Each child's behavior at school class room, home, during travel to school, at play ground etc., Inheritance – The process of acquiring the behavioral characteristics from previous class of study or from parents/grandparents etc., Encapsulation – Wrapping up of child's attributes and behavior under single head. This type of modeling will allow the stake holders to keep track and promote the activities which are needed to improve the learning ability and multidimensional growth of the child. This is a conceptual analysis and modeling formalized in a meta-model with the help of Unified Modeling Language diagram symbols.

Index Terms – Education, Encapsulation, Identity, Inheritance, Object Oriented, Polymorphism.

Glossary: Process – means the teaching and learning process
Program/system –Pre-primary/ primary education

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I. INTRODUCTION

Many of the schools are following the conventional method of teaching today. The conventional method is like, preparing the syllabus either by central board or state board of education and making it to study for all the children of the same age and class. But each child is having its own natural learning ability and capacity. A primary school teacher helps the students to develop the learning, thinking and problem solving skill that will act like stepping stone for lifelong learning for the child [1-3].

Primary teachers are required to teach the basics of the subjects like English, Mathematics, Science and Technology, Human society and its environment, creative and practical arts, personal development, Health and physical development etc. The continuous evaluation process like formative and summative assessments will give the grades to the students like A1, A2, B1, C and D etc. This leads to inferiority complex, if child scores lesser grade. So there is a strong need for grade free teaching and learning for pre-primary and primary school children. The object oriented curriculum design and modeling will contribute significantly in overall development of the child. The usage of unified modeling language (UML)[8] will help the teachers and school management to have the teaching and learning model before start of the semester or academic year. The distinct model can be used for a particular group of students of same age. In the traditional software engineering process we do have sequence of stages to build good software to satisfy the needs and requirements of the customer. The same steps can be applied to build a teaching and learning model, which will act like a perfect plan to make a child happy learner. The object oriented analysis mainly focuses on the characteristics like, Identity, Polymorphism, Inheritance and Encapsulation[8]. The analysis will include the present status of the child and needs of the stake holders. The inherited characteristics of the child must be considered for the analysis process, like what significant improvement has been observed or what the laps are. So with this, individual identity can be created. The child's behavior in the school, outside the school, during the travel towards the school, at home etc., has to be noted and included this in the needs analysis (this is polymorphism). The needs must be rigorously collected and analyzed prior to the start of the educational process. The classifying the child in accordance with needs and requirements is known as classification (Encapsulation).

This analysis can be modeled using UML tools to simplify the follow up process and continuous monitoring the educational process.

II. METHODOLOGY

The normal software development process employs the model known as waterfall model, which includes the steps like; Requirement analysis stage, Design stage, Implementation stage and Testing stage [8]. The proposed conceptual model also follows the same steps with the educational terminology. The requirement analysis stage is taken as needs analysis of the child, parents/guardian. Design stage is teaching-plan with specific curriculum. Implementation stage is teaching and learning process for the semester/academic year. Testing stage is a process of examining the child with specific procedure. This whole four

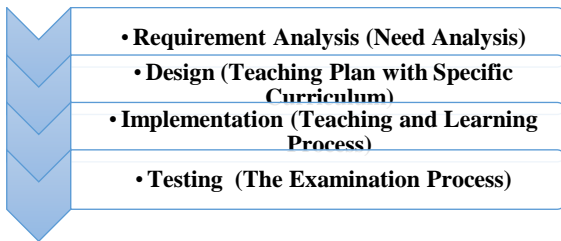


Figure 1 OOA based Teaching and Learning Model

stage process must be formulated with verification and validation, before actual process of teaching and learning process begins i.e. the model that has been built is to be tested rigorously under the supervision of principal /Administrator /External Senior well experienced Teachers. The verification includes “have we built the model right?” (i.e., does it match the specification)? The validation includes testing of “whether we built the right process model?” (i.e., is this what the stakeholder wants)? The terms verification and validation are commonly used interchangeably in the institution; it is also common to see these two terms incorrectly defined. The

Figure 1 demonstrates the whole process.

A. Parents/ Teachers’ requirements

- Making the child more attentive
- Making the child less Aggressive
- Making the child Active
- Reducing the Hyper activeness
- Improving the writing skills
- Improving reading skills
- Making the child to mingle with teachers, friends, seniors, supporting staffs and others
- Making the child to be responsive., etc

B. Child Requirements

- Child wants to play all time
- Wants to listen music
- Happy with cartoon films
- Like to hear jokes/comic kind of talk
- Likes to eat chocolates/Junk food
- Wants his belongings to be scattered., etc

Based on the above requirements, the analyst has to set goals and objectives for development of the child. Use one space after periods and colons.

C. Goals and Objectives

The objective behind the proposed model is to consider the requirements and set the objectives and goals to meet the needs of the parent/child/ teachers. These well defined goals and objectives based on the needs will serve as a foundation for the final product. It is important that an agreement of these requirements be reached so that everyone’s expectations will be met. This document uses written descriptions as well as various types of modeling diagrams to illustrate the high level structure of the proposed system. Although some of these models may seem to convey similar information they typically do so from an alternate perspective. This gives different stakeholders a view of the requirements that is better suited to their area of responsibility.

This conceptual model is intended to provide a need based teaching and learning system that will assist the teachers, parents and school management to make a child happy learner. Many of the typical functions involved in operating the entire process will be conceptually automated through operational workflow within a facility. This Requirements Specification will describe these as well as many other features of the process in greater detail.

D. Statement of scope

This section contains a general description of the proposed process functionality followed by detailed requirements that will be traced throughout the educational process.

Before indulging into conceptual system, the stake holder will be required to submit their requirement statement. The teacher, principal in consultation with parents, frames the complete curriculum to inculcate the valid needs which may help the overall development of the child.

E. Stakeholders’ needs for the children’s development

Req. No.	Priorit y	Reference	Description
Behavior	High	Parent /Teacher	The collection of behavioral requirements with respect to parents, teachers.
Activeness/ Hyper activeness	High	Parent /Teacher	The teachers observe the activeness of the child during teaching and learning process and parents observe the activeness of the child at home or while playing with neighbors’ children.
Habits	High	Parent /Teacher	The teachers observe the good and bad habits of the child during teaching and learning process and parents observe the good and bad habits of the child at home or while playing with neighbors’ children.
Hobbies	High	Parent /Teacher	The teachers observe the good and bad hobbies of the child during teaching and learning process and parents observe the good and bad hobbies exhibited by the child at home or at any other place.
Reading Skill	High	Parent /Teacher	The teacher has to monitor the reading skill development along with the parents

Writing skill	High	Parent /Teacher	The teacher has to monitor the writing skill development along with the parents
Daily reminders	High	Parent /Teacher	The teacher and parent have to be in touch with each other daily on the child's observations
Weekly summary	High	Parent /Teacher	The teacher and parent have to communicate with each other weekly on the child's observations
Monthly summary	High	Parent /Teacher	The teacher and parent have to communicate with each other monthly on the child's observations

F. Design context

There are many key components to the teaching and learning profession. But the ability and willingness to attain the objective depends on dedication, management, ability to retain children and establish a plan for growth. The motto behind the well framed and planned model is to give well supervised plan of action for the overall development of the child. The software engineering techniques follows many methods like for example waterfall model which will help the software developer to analyze, design, implement and test. Similarly this waterfall model can be utilized for devising the proposed model.

G. Model Requirements Specification

The requirement specifications can be represented through use-case diagram. Use-case is the functionality module within the system. And the actor is one who interacts with the use-case directly. This type of relation is depicted through use-case diagram.

The following definitions describe the actors in the system.

Principal	The Principal has the responsibility for assigning tasks depending on the needs listed for teachers and Children and respective parents.
Teacher	A teacher has the responsibility for meeting the valid needs of the stakeholders
Parent/Guardian	Have to respond according to the communication had between Principal and Teacher
Child	Follow the Principal, Teacher and Parents/Guardians

H. Use-Case Diagram

The use-case diagram in Figure 2 shows four actors that were described in section 2.1. For instance, every use-case will typically involve an interaction with the process.

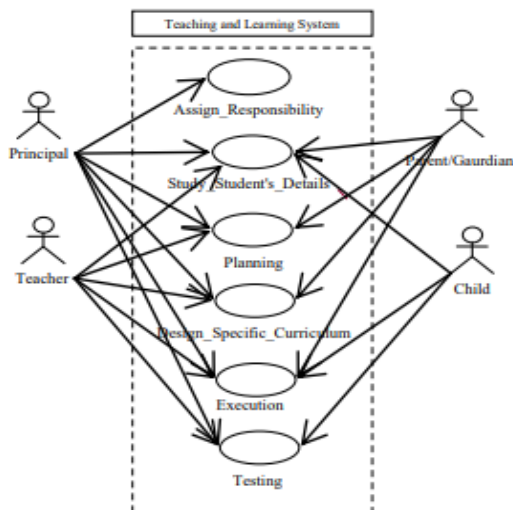


Figure 2 Use-case diagram

Use-case:	Assign_Responsibility
Primary actor:	Principal
Goal in context:	To find suitable teacher to meet the needs of the stake holders
Preconditions:	Principal should know the strengths of the teacher
Trigger:	When complete needs from the stake holders are known
Scenario:	<ol style="list-style-type: none"> 1. Principal collects needs of the stake holders. 2. Principal finds the suitable teacher for the specific needs. 3. Assigns the responsibility to the identified teacher.

Use-case:	Study Students' details
Primary actor:	Teacher
Goal in context:	To know the student's area to improve
Preconditions:	All the information regarding students must be collected
Trigger:	After getting the responsibility from Principal
Scenario:	<ol style="list-style-type: none"> 1. Principal collects needs of the stake holders. 2. Principal finds the suitable teacher for the specific needs. 3. Assigns the responsibility to the identified teacher. 4. Collects the information regarding student from Principal 5. Analysis

Use-case:	Planning
Primary actor:	Parent/Guardian, Teacher, Principal
Goal in context:	To devise specific curriculum and plan of action for the child
Preconditions:	All the information regarding students must be collected
Trigger:	After classification of children with similar requirements
Scenario:	<ol style="list-style-type: none"> 1. Teacher classifies the students according to the needs of the stake holder. 2. Confirmation about needs classified from the stake holders. 3. Plan the schedule for imparting specific curriculum.

Use-case:	Design Specific Curriculum
Primary actor:	Parent/Guardian, Teacher, Principal
Goal in context:	To devise specific curriculum for the child
Preconditions:	All the information regarding students must be collected
Trigger:	After classification of children with similar requirements
Scenario:	<ol style="list-style-type: none"> 1. Teacher classifies the students according to the needs of the stake holder. 2. Confirmation about needs classified from the stake holders. 3. Plan the schedule for imparting specific curriculum.

Use-case:	Execution
Primary actor:	Child, Teacher, Principal and Parents /Guardian
Goal in context:	To address specific needs identified from the stake holders.
Preconditions:	Plan of action with curriculum design
Trigger:	After planning and Curriculum design

Scenario:	1. Initial and basic behavioral need addressing. 2. Specific learning objective addressing 3. Fundamental things like communication and different skills required for the professional development 4. Analysis
Use-case:	Testing
Primary actor:	Teacher, Child
Goal in context:	To know the progress of the child
Preconditions:	Child must have passed through all the planned process
Trigger:	After executing planned curriculum
Scenario:	1. Teacher, Parents and Principal agrees for the test 2. Test plan 3. Study the students behavior at various mentioned places 4. Specific tool and technique used for the learning ability of the child 5. Analysis

Design (Teaching and Learning Plan with specific curriculum, framed during need analysis) Design is a process of problem-solving and planning for a teaching and learning solution. After the purpose and specifications of teaching and learning are determined, the teachers will design to develop a plan for a solution. It includes low-level component and procedure implementation issues.

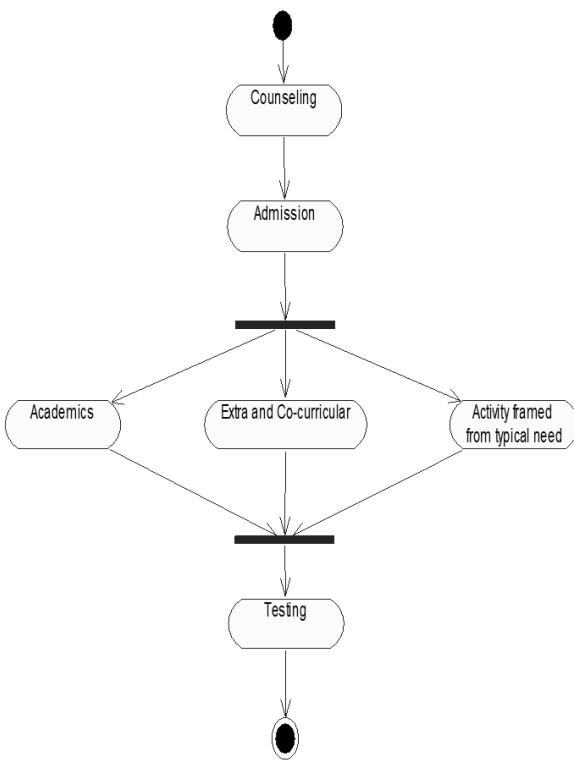


Figure 3 Activity Diagram

The activity diagram of Figure.3 shows the relationship and the flow between each activity. Each activity in turn may have set of sub-activities and can be represented with separate activity diagram to facilitate the whole teaching and learning process. In Figure.3, each oval shape is an activity and arrow is the flow of the activity.

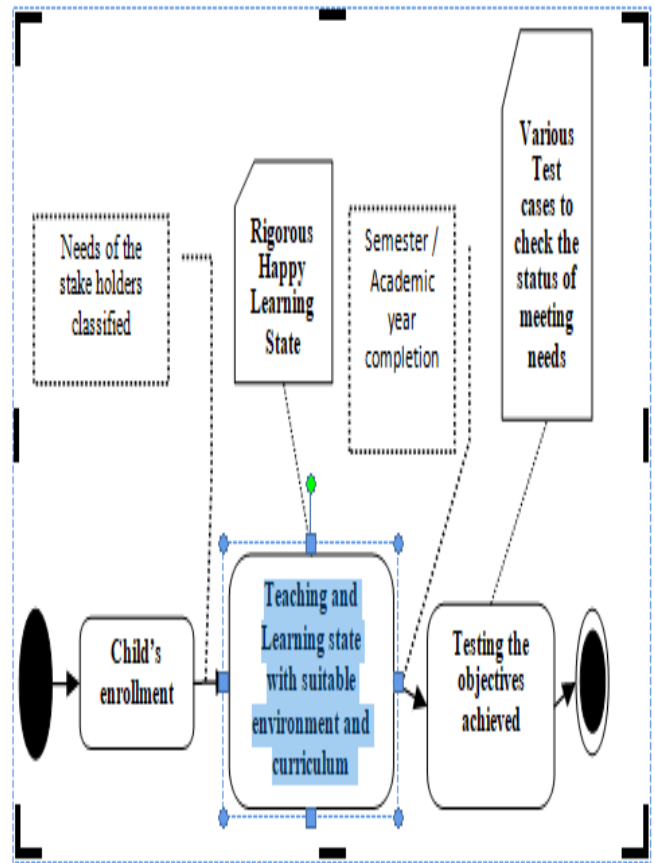


Figure 4 State transition diagram

The state transition diagram of Figure.4 shows the present status of the child. It's a dynamic representation to know in which state the child is and the event which causes the change of state. The round cornered rectangle represents state and labeled arrow is an event to cause change of state. Each state can be framed as one more state diagram and can be taken as nested state diagram.

III. IMPLEMENTATION ISSUES AND CHALLENGES

Following are the set of fundamental implementation concepts that has to be taken care [8]:

1. Abstraction - Abstraction is the influence of generalization by reducing the information content of a needs or an observable phenomenon, typically as a way to preserve the information which is primary for a distinct rationale outlined.
2. Refinement - it is the procedure of elaboration. A hierarchy is developed by way of decomposing a macroscopic need statement of an activity in a stepwise fashion except implementation statements are reached. In each and every step, one or a number of directions of given implementation details are decomposed into more detailed directive paths. Abstraction and Refinement are complementary concepts.
3. Modularity – educating and studying architecture is split into add-ons referred to as modules.
4. Educating and studying architecture - It refers to the overall constitution of the procedure and the methods wherein that structure supplies conceptual integrity for a method.



A teaching and learning structure is the development work product that offers the absolute best return with respect to excellent quality and schedule.

5. Control Hierarchy - A programme constitution that symbolizes the institution of programme add-ons and implies a hierarchy of control.
6. Structural Partitioning - The programme structure may also be divided both horizontally and vertically. Horizontal partitions outline separate branches of modular hierarchy for every most important programme function. Vertical partitioning suggests that manipulate and work will have to be distributed top down in the programme constitution.
7. Information constitution - it's an illustration of the logical relationship amongst contributors like stakeholders.
8. Programme - It makes a specialty of the processing of each module personally
9. Information Hiding - Modules will have to be special and designed in order that understanding contained inside a module is inaccessible to other modules that don't have any need for such understanding.

Considerations:

There are a lot of points to take into account within the design of teaching and learning model. The significance of each and every point should mirror the pursuits that procedure is making an attempt to acquire. A few of these points are[8]:

Compatibility - The model is capable to function with different approaches which can be designed for interoperability with other processes.

Extensibility - New capabilities may also be introduced to the process without important changes to the underlying structure.

Fault-tolerance - The system is proof against and in a position to recuperate from component failure[7].

Modularity - The resulting model should contain the good, defined and unbiased components. That should lead to better follow up. The components might be then applied and verified in isolation earlier than being integrated to kind the desired procedure. This allows for division of work.

Reliability - The process framed is ready to perform a required function beneath stated stipulations for a targeted interval of time.

Reusability - The modular activities framed should seize the essence of the needs anticipated out of them and no more or less. This single-minded purpose renders the methods reusable wherever there are identical needs.

Robustness - The process framed is able to operate on exceptional occasions. For instance, it can be designed with resilience to slow reactive capability.

Security - The process framed is in a position to resist antagonistic acts and influences.

Usability - Any stakeholder will also be concerned with the system framed.

Implementation:

Implementation stage is effective execution of the plan in accordance with the design. It may include several implementation tools which leads to happy learning, likely; Chalk – board, Smart class, Field knowledge, Activities, Class room discussions, Making outside resource person to

interact, Reading and writing practices, Making parent representative to interact with students etc.

Modeling language[8] is any artificial language that can be used to express expertise or competencies or programs in a constitution that is outlined with the aid of a steady set of rules. The rules are used for interpretation of the meaning of components in the constitution. A modeling language can be graphical or textual. Examples of graphical modeling languages for application design are Unified Modeling Language (UML) which is a basic modeling language to explain process both structurally and behaviorally. It has a specific set of graphical notations and relevant significance of each graphical symbol.

IV. TESTING (THE EXAMINATION PROCESS)

Testing is an investigation conducted to provide child/parents/guardian/teacher with information about the percentile of success of the teaching and learning process under test. Testing also presents the purpose, impartial view of the procedure to enable the stakeholder to recognize and appreciate the efforts at implementation of the process. Test strategies comprise, however usually are not restricted to, the model of executing a plan with the intent of finding bugs[4],[5],[8]. Testing can also be acknowledged because the method of validating and verifying that a teaching and studying process- whether meets the needs of the stakeholders and technical specifications of the implementations guided its design and progress? Whether or not technique and methodology adapted to impart the schooling works as expected?

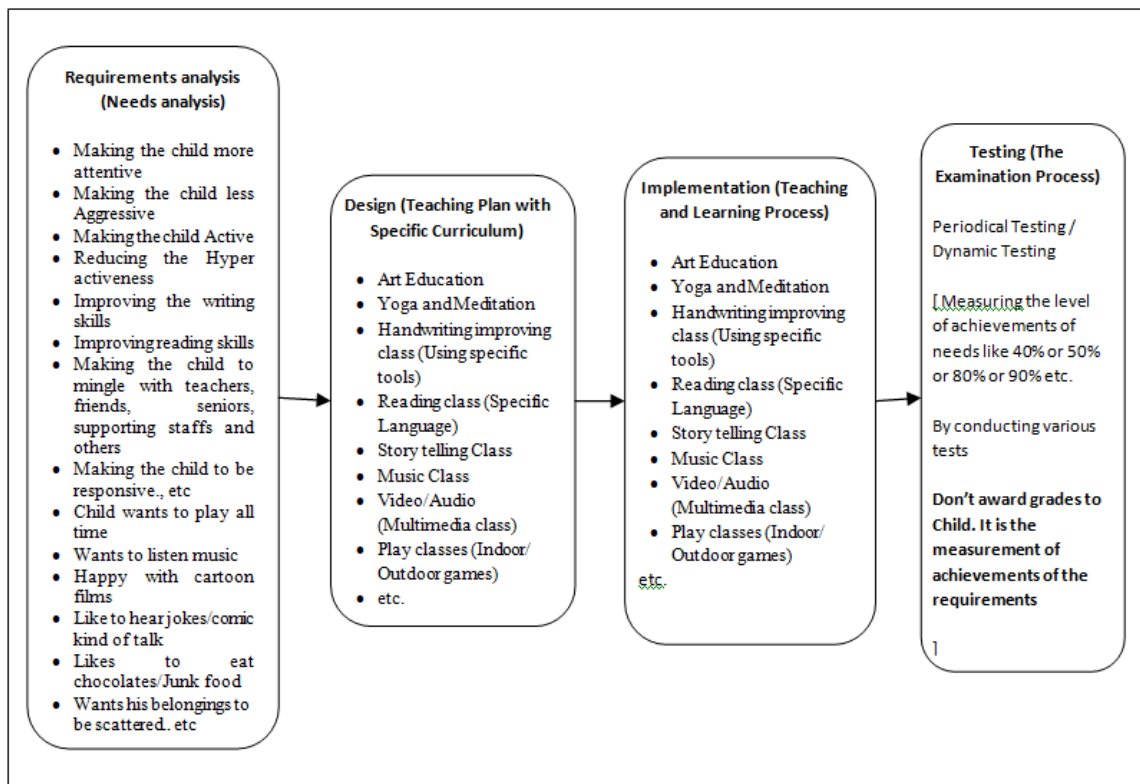


Figure 5. Sample model for Object Oriented Pedagogy

An important rationale for testing is to observe teaching and learning system hurdles, so that hurdles could also be uncovered and corrected. This can be a non-trivial pursuit. Testing cannot establish that a model services adequately underneath all conditions,

but can only set up that it may not operate thoroughly under specific stipulations.

The scope of testing almost includes analyzing the process adapted to impart education as good as the execution of that method in more than a few environments and conditions as good as inspecting the aspects of the system: “does it do what it is intended to do and do what it needs to do”.

In the current culture of educational process, a testing is done by subject teacher and process is supervised by Principal/Administrator. But if the testing is executed by separate well formulated testing team, then it is very easy to identify the success rate of the process adapted. There are various roles for testing team members. Functional tests tend to answer the question of “can the child do this” or “do this process keeps child happy and burden free”.

Non-functional testing refers to aspects of the teaching and learning process that may not be related to a specific function or child action.

Non-functional testing tends to answer such questions as "how many children are improved to the level of satisfaction", or "how many teachers delivered the task successfully ". One common source of expensive defects is caused by requirement gaps, e.g., unrecognized requirements that result in errors of omission by the teacher.

Static Vs dynamic testing:

There are many methods to test the child’s progress. Reviews, walkthroughs, or inspections are considered as static testing, whereas truly executing with a given set of experiment instances is known as dynamic testing. In a similar fashion, this can be adapted to teaching also[8].

Static testing will also be employed at end of each and every sub process. This can be to verify the working glide of the procedure. Dynamic testing takes location when the procedure itself is used for the first time (which is probably regarded the beginning of the testing stage). Dynamic testing may begin before the method is 100% complete in an effort to scan special sections of a process (modules or discrete processes)[8].

Specification-based testing: this is to scan the learning capability of the child in step with the needs specific. This stage of testing is most likely requires thorough scan cases to be supplied to the tester, who then can simply confirm that for a given input, the output worth (or behaviour), either "is" or "is just not" the identical with the expected value in the test case[8].

V. DISCUSSION AND CONCLUSION:

The employing the software project modeling technique with object oriented modeling has greatly reduced the fault tolerance and increased the percentage of satisfactory deployment of the product[7]. In the same way object oriented modeling for teaching and learning process in pre-primary and primary education will greatly reduce the burdens on children, parents, school management and teachers. The analysis will include the present status of the child and needs of the stake holders. The inherited characteristics of the child must be considered for the analysis process, like what significant improvement has been observed or what the laps are. So with this individual identity can be created. The child’s behavior in the school, outside the school, during the travel towards the school,

at home etc has to be noted and included this in the needs analysis (this is polymorphism). The needs must be rigorously collected and analyzed prior to the start of the educational process. The classifying the child in accordance with needs and requirements is known as classification (Encapsulation). This analysis is modeled using UML tools to simplify the follow up process and continuous monitoring the educational process. The use-case model simply tells how the stake holders involved in the process of teaching and learning. The activity diagram shows how to frame the activities to cope-up with the needs of the stake holders. The usage of state transition diagram will focus on the present status of the child after each educational event. The testing process includes the testing of the model; whether the model works properly or not. And another phase of the testing include the testing the child through various examination process to enable the child to advance towards next grade of learning in school.

REFERENCES

1. Muhonen, H., Rasku-Puttonen, H., Pakarinen, E., Poikkeus, A. M., & Lerkkanen, M. K. (2017). Knowledge-building patterns in educational dialogue. *International Journal of Educational Research*, 81, 25-37.
2. Carroll, A., Bower, J. M., & Muspratt, S. (2017). The conceptualization and construction of the Self in a Social Context—Social Connectedness Scale: A multidimensional scale for high school students. *International Journal of Educational Research*, 81, 97-107.
3. Isohäätä, J., Järvenoja, H., & Järvelä, S. (2017). Socially shared regulation of learning and participation in social interaction in collaborative learning. *International Journal of Educational Research*, 81, 11-24.
4. Bresciani, P., Perini, A., Giorgini, P., Giunchiglia, F., & Mylopoulos, J. (2004). Tropos: An agent-oriented software development methodology. *Autonomous Agents and Multi-Agent Systems*, 8(3), 203-236.
5. Ty, P., Harahap, I. S., & Yee, N. C. (2017). Object Oriented System as Applied to Jack-Up Analysis. *Indian Journal of Science and Technology*, 10(3).
6. Stewart, A., Cardell-Oliver, R., & Davies, R. (2017). A fine-grained framework for quantifying secure management of state in object-oriented programs. *International Journal of Computers and Applications*, 39(1), 9-16.
7. Kaur, I., Narula, G. S., & Jain, V. (2017). Differential analysis of token metric and object oriented metrics for fault prediction. *International Journal of Information Technology*, 9(1), 93-100.
8. Blaha, M., & Rumbaugh, J. (2005). *Object-oriented modeling and design with UML* (pp. I-XVII). Upper Saddle River: Pearson Education.

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