Multi-Agents to Work with Primary Child: Expert Agents Architecture and Implementation

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Abstract–**As an important part of today's socio-techno-ecosystem, it is very vital to acknowledge the importance of primary education. Problems like fair distribution of resources, resources utilization, and microscopic concern on aspects related to the psychology of a child cause any primary education system, globally, face significant challenges when being implemented.CHILD@EDU is an alias given to a piece of research and development work which has being initiated to find solutions for these matters in primary education. CHILD@EDU fundamentally targets the children that involve in Primary Education whileproposing a knowledge system that addresses the vital and sensitive attributes of a common primary education system (known as the fundamental characteristics of a child with effective learning abilities). This paper is intended to publish the technical research, architecture, and implementation work related to the Expert Agents module of CHILD@EDU. This distributed multi-agent architecture has been tested in the means of project CHILD@EDUto be functioning with a higher accuracy adhering to the ontological expert decision support based on international WISC®-IV Assessment Standards.**

1. Introduction

The time that the child spends with the teachers determines the best quality aspects of his/her entire life. As the first step of the compulsory education, it is very vital to acknowledge the importance of primary education.

However, any primary education system faces some key problems, especially, when addressing the needs of measuring children's hidden intelligence and cognitive abilities. The term "CHILD@EDU" has been used as an alias given tothe research and development work which was initiated to find solutions for these matters in primary education.[11] CHILD@EDUconsisted of two major phases to solve the addressing problems:

- Research on Current Primary Education System and Child Psychology
- The Internet based knowledge system

CHILD@EDUhas been implemented using Multi Agent Artificial Intelligence Technology with the support of other AI and software design technologies such as Ontology [6], Web Services, Web 2.0 rich web applications, and WPF network oriented user interfaces. Its physiological evaluation is based on the international standard of WISC-IV [1, 3].

This paper is intended to publish the technical research, architecture, and implantation details of CHILD@EDU Expert Agents module. In demonstration purposes, it has been developed using JADE and integrated to CHILD@EDU Java service-application-core. Nevertheless, this architecture is strongly coupled with WISC®-IV Assessment Standards Ontologies derived from WISC-IV rules. However, the objective of such exemplary implementation is to showcase the abilities that Multi-Agent technology has over real-time school education systems.

2. Problem in Brief

[11]Any primary education system, globally, faces some key problems that cannot be addressed via direct human agency or the application of any ordinary information system. Science has proved that a primary child's mental processing is very difficult to be understood by ordinary human beings due to the lack of significant and stable modes of communication that the child has with the environment. Scholars show that trying to develop a child to near perfect human being is just like trying to finish a micro sculpture with higher level of details [7]. Thus, a special framework/approach is required to address the following problems to achieve effective primary education:

- One Teacher-One Child education is not globally possible due to lack of resources and skilled personnel.
- All Teachers or parents are not expert child psychologists or physiatrists.
- Effective report generation of a child's educational attributes is important.
- Who supports the task of teachers? With the growing complexity of environment, even the teachers must be guided to be productive.

- Parents, Education Institute, and Children must be integrated.
- System of Systems is needed for efficient government decision making.

With the increasing complication of this problem domain, a consistent methodology to model its complexity is required in order to let a digital system work hand-in-hand with teachers. Thus, in order to achieve it, there should be a dependable manual standard, set of rules, or a protocol for educating, interacting with, and evaluating children as well as a technology that supports effective modeling of knowledge derived from that manual mechanism.

3. Overview- JADE and WISC-iv

JADE (Java Agent DEvelopment Framework) and Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV)have been prioritized as the key technologies of this research. The project's aim has been set to find the application of these technologies to produce a knowledge system that can support primary education to increase its quality and resource utilization.

A. JADE (Java Agent DEvelopment Framework)

JADE (Java Agent DEvelopment Framework) [9] is a software Framework fully implemented in Java language. It simplifies the implementation of multi-agent [11] systems through a middle-ware that complies with the FIPA specifications and through a set of graphical tools that supports the debugging and deployment phases. The agent platform can be distributed across machines (which not even need to share the same OS) and the configuration can be controlled via a remote GUI. The configuration can be even changed at run-time by moving agents from one machine to another one, as and when required. JADE is completely implemented in Java language and the minimal system requirement is the version 1.4 of JAVA (the run time environment or the JDK) [9, 15].

JADE heavily supports the implementation of CHILD@EDU as well. Especially due to its supportability and compatibility with Protégé, the compliance Java code can be easily generated from the ontology conceptual model [15].

B. Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV)

Despite all the innovations and exemplary quantitative and qualitative characteristics of new and recently revised intelligence tests, the Wechsler scales continue to reign supreme. In fact, the Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV) [1, 3], like its predecessor—the WISC-III—will very likely become the most widely used measure of intelligence the over world. Because the latest edition of the WISC represents the most substantial revision of any Wechsler scale to date, CHILD@EDU's task of developing an interpretive technology system for evaluating children and monitoring their learning and intelligence attributes using WISC-IV [1, 3] becomes psychometrically, technologically, and theoretically defensible.

This scientific approach for evaluating children offers 10 types of compulsory subtests and 5 optional subtests for taking measurements. The following are the 10 compulsory tests that are simulated through CHILD@EDU:

i. ***Block Design (BD):*** The examinee is required to replicate a set of modeled or printed two-dimensional geometric patterns using red and-white blocks within a specified time limit.
ii. ***Similarities (SI):*** The examinee is required to describe how two words that represent common objects or concepts are similar.
iii. ***Digit Span (DS):*** On Digit Span Forward, the examinee is required to repeat numbers verbatim as stated by the examiner. On Digit Span Backward, the examinee is required to repeat numbers in the reverse order as stated by the examiner.
iv. ***Picture Concepts:*** The examinee is required to choose one picture, from (PCn) among two or three rows of pictures presented, to form a group with a common characteristic.
v. ***Coding (CD):*** The examinee is required to copy symbols that are paired with either geometric shapes or numbers using a key within a specified time limit.
vi. ***Vocabulary (VC):*** The examinee is required to name pictures or provide definitions for words.
vii. ***Letter-Number:*** The examinee is read a number and letter sequence and is Sequencing (LN) required to recall numbers in ascending order and letters in alphabetical order.
viii. ***Matrix Reasoning:*** The examinee is required to complete the missing portion (MR) of a picture matrix by selecting one of five response options.
ix. ***Comprehension:*** The examinee is required to answer a series of questions (CO) based on his or her understanding of general principles and social situations.
x. ***Symbol Search (SS):*** The examinee is required to scan a search group and indicate the presence or absence of a target symbol(s) within a specified time limit.

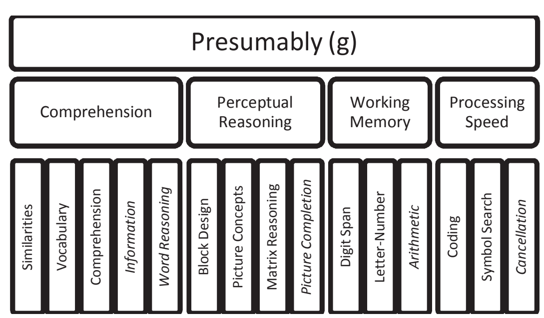

Figure1: WISC-IV Subtests for Evaluating Children

4. Overview of The Approach: CHILD@EDU and Expert Agents Module

A. Overview of CHILD@EDU Approach

As it was mentioned above, the project CHILD@EDUhad been focused to research an effective way to involve with a primary child while teaching, monitory, and evaluating him/her. Its basis of study has been influenced by characteristics of a successful child in education, measurement methods to evaluate a child, standards of Primary Education Systems, mechanism to introduce computer agency instead of human agency, and the cardinality and capacity of required Computer Agency.

The most important aspect of CHILD@EDU is that as a final output it generates activities for children which target a composition of measuring subtests. These activities will be in either one of 5 types:

i. Reading
ii. Writing
iii. Symbolic
iv. Numeric
v. Motor

However, most of the world wide syllabuses (case studied on Sri Lanka Local and Cambridge Syllabuses) group these five subject areas into three classes from Elementary to Grade three education as follows;

i. Language,
ii. Numbers and Mathematics,
iii. Environmental Studies

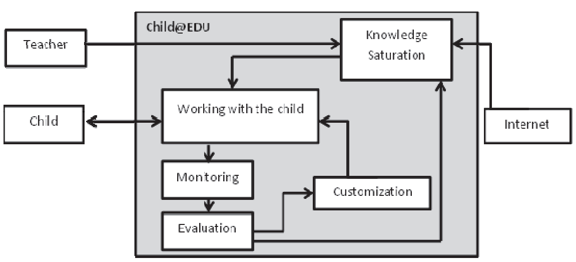

Figure2: CHILD@EDU Generic Process Flow

In abstract viewpoint, the system acts as a testing surface to measure and monitor the educational progress of a primary child. In order to support this task, international standard of Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV) [1, 3] has been used. However, the main difference between an ordinary system and CHILD@EDU is that the extra focus it gives to employment of expert software agents of WISC-IV [1, 3] that monitor, evaluate, and report on a particular micro area of the learning child. This helps the system to identify talented children as well as children with deficiencies and automate the progression of learning curve of each individual child effectively through customization of course work and deploying teamwork. The summary of the process of this CHILD@EDU prototype can be elaborated as in the above Figure.

B. Overview of CHILD@EDUExpert Agents Module

The solution for handling the complexity of the domain, working with the adhering standards of WISC-IV, and modelling the knowledge and the rules, as CHILD@EDU suggests, is the use of distributed, work-delegated, multi-swarm expert agents. These computer agents may focus on micro aspects of the primary education mechanism and the standard that the underlying Ontology and their local ontologies define. As CHILD@EDU adheres to WISC-IV international standard, its expert agents also provide services based on WISC-IV from generating activities for the children (through the provided Man-Machine interface) to monitoring and evaluating their activity.

5. Design of CHILD@EDU andIts Expert Agents Module

A. Overview of the design of CHILD@EDU

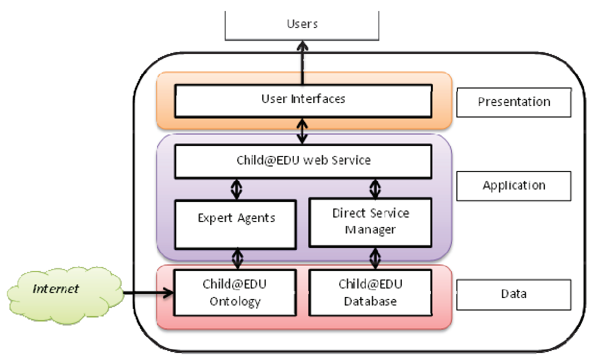

Figure3: Top Level Architecture of CHILD@EDU

Figure3 shows the top level architecture of this CHILD@EDU prototype which will be the output of this project. The architecture contains three main layers, as discussed above: Data Layer, Application Layer, and Presentation Layer.

- ***The Data/Knowledge Layer*** contains the main modules of CHILD@EDU ontology and the non-ontological relational database. The ontology [6] uses the trusted sources from the Internet in addition to the user inputs in the knowledge saturation process.
- ***Application Layer*** contains three main modules: the expert agent module, which employs multi-agent technology, direct service manager module to provide encapsulated logic of accessing the relational database to the web service, and CHILD@EDU web service itself.

- ***Presentation Layer*** contains the Network based user interface provided for the users of the system. The GUI is web oriented due to the technical feasibility and to ensure higher availability anywhere anytime.

B. Expert Agents Module

The most important as well as the complex module of CHILD@EDU is the Expert Agents Module, which resides in its application layer. It contains a pool of software agent swarms. Among the application layer agents, the tasks of creating activities for children that composes few subtest elements together and operating subtests separately for evaluation run separately. The knowledge for the expert agents to function on comes from the underlying CHILD@EDU Ontology. In abstract view, agent swarms operate in two categories as;

Activity Operating Agents:

These are the agents that construct composite activities adhering to multiple subtests or one subtest. They are responsible of;

- Producing actives adhering to the recommendations given by the experts of relevant subtest/s.
- Transferring the metadata required to generate user interfaces in presentation layer.
- Retrieve the response parameters from user-interfaces related to the users' interaction.
- Delegating these response parameter to expert agents for evaluation

There are three (3) swarms of agents of this nature in order to generate activities of five main modes

- *Language Activity Generators*
- *Numeric Activity Generators*
- *Environmental Activity Generators*

WISC-IV Oriented Subtest Expert Agents:

These agents has specialized knowledge in each subtest closely related to WISC-IV [1, 3] standard. These agents provide the insight needed for the Activity Operating Agents to produce activities and evaluate the delegated responses related to the relevant subtest. For each major subtest out of all ten (10) there exists a swarm of agents.

In addition to that, there are five significant agents:

i. ***The central message space***: Responsible for the coordination of all the other swarms
ii. ***Course conductor:*** Responsible of structuring and conducting a course according to the progression and formulate the exercises in a particular course.
iii. ***General Evaluator***: Responsible of evaluating exercises and a course as a whole. These agents are also responsible for combining the evaluations of each of the evaluations made by the other expert agents and output the progress measurements of the child on that particular exercise and in a time series manner.
iv. ***Class Administrator***: Responsible of directing the class with respect to managing the student profiles, teacher profiles, and other class infrastructure oriented tasks of a class
v. ***Web Service Agent***: A new concept, to support the concurrency model of web service. This agent allows the Agent Experts Module to be loosely coupled with the Web Service module and acts as the Only Request Agent for the central Message Space.

Each of these swarms follows the traditional architecture of Request-Resource-Message-Ontology multi-agents [12]. The following figures demonstrates the adoption of this architecture and the way the sample swarm communicates with the central message space agents.

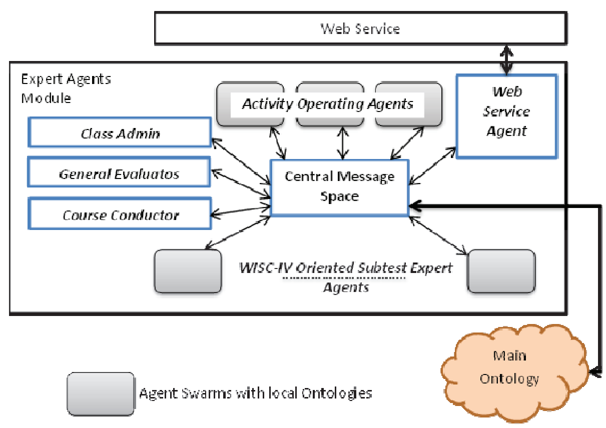

Figure4: Top Level Design of Expert Agents Module

6. Implementation Summary of CHILD@EDU Expert Agents Module

As it was clearly shown in last chapter, CHILD@EDU occupies a pool of software agents as swarms to achieve higher efficiency in software process and knowledge handling. As it was discussed there are two types of agents as Activity Operating Agents and Subtest Expert Agents and three other uncommon swarms of agents as Course Conductors, General Evaluators, and Central Message Space.

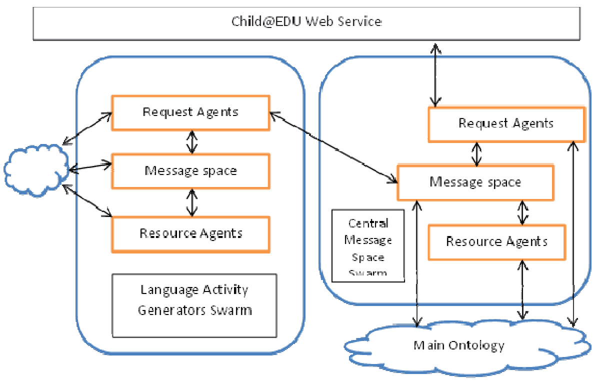

Figure5: Multi-Agent Architecture of Expert Agents Module.

As the key technology of implementing agents, JADE plays a crucial role [9]. From initiation though execution, suspension, and resumption to the termination of agents. JADE is a middleware that facilitates the development of multi-agent systems acting as a platform for Agents and a container [12]. It includes;

i. A runtime environment where JADE agents can "live" and that must be active on a given host before one or more agents can be executed on that host.
ii. A library of classes that programmers have to/can use (directly or by specializing them) to develop their agents.
iii. A suite of graphical tools that allows administrating and monitoring the activity of running agents.

Thus, the developer only has to worry about designing the agent swarms, defining their behaviours, defining their communication, and linking them to the knowledge sources.

This prototype of CHILD@EDU employs 16 different types of agent swarms to reach for its heights. These include five (5) different Activity Operator swarms, ten (10) Subtest Expert swarms for each subtest with relevance to WISC-IV [1, 3], and three special swarms to maintain the consistency of the system.

A. Agents in an Activity Operators Swarm

As it was mentioned earlier, there are three (3) different activity operator agent swarms for generating writing and alphabet reacted activities, Symbols related activities, numeric and mathematics activities, and creativity and motor aspects related activities of the following syllabus.

The agents in these swarms have fewer similarities with contrast to the agents in Subtest Swarms. The behaviourof these agents generally are for formulating and carrying out a learning or testing activity with the child. Though they are dependent on the data they receive via the web service, they consider that the responses directly come from the users of the system. The agent of an Activity Operating Swarms can be categorized into two classes.

i. Activity Generators: Responsible for generating a learning or testing activity for the child from a collaborative effort.
ii. Activity Evaluators: Deal with the responses of the user and conclude the activity

The following flow of steps explains the abstract functionality of and Activity Operating Agent Swarm.

i. The Request Agent (RA) of the relevant Activity Operating Swarm is spawned by the Central Message Space (CMS)
ii. CMS provides the RA the information on what type and level of activities must be generated for the active child
iii. RA, though the local message space of the swarm spawns the activity generators (AGs)
iv. AG agents, though the central RA and Central Message Space call upon the service of relevant Subset Experts for generating the Activity
v. AGs generates the activity once the Subtest knowledge is received
vi. AGs passes the activity meta-knowledge to RA which is transferred to the presentation layer through web service
vii. AGs are terminated
viii. Local Message Space spawns Activity Evaluators (AEs) to monitor and record the progress of the activity
ix. AEs update the Subtest swarms through local RA and CMS with updates until the activity is over.
x. Once the Activity is over, AEs via RA and CMS update the General Evaluator with the evaluation results from the subtest swarms.

B. Agents in a Subtest Expert Swarm

All Subtest Agents Swarms function in similar manner. Each of these Swarms has a common combination of agents as shown in Figure 6. The requests agents are the only agents in these swarms that contact with the external world. The other agents inform the request agents their need of external contact via the local message space so that request agent can facilitate them in their task letting these other resource agents to engage in their remaining tasks asynchronously. However, as it was described earlier, the major responsibility of these kinds of swarms is to create, monitor, and evaluate their rightful and respective subtest (e.g.: Block Design, Similarities, Digit Span, etc.). The abstract flow process flow of these swarms is shown in Figure7.

Central Message space spawns the relevant subtest request agents as a result of an OneShotBehaviour. Along with this spawning, the request agent communicates with local message space which then spawns the necessary local agents to carry out the subtest. The Subtest Constructors generate the subtest and prepare it for the user interaction. Likewise the

Subset Monitors keep track of the change of states in the subtest and finally, Subset Evaluators evaluate the subtest with reference to WISC-IV standard evaluation [1, 3].

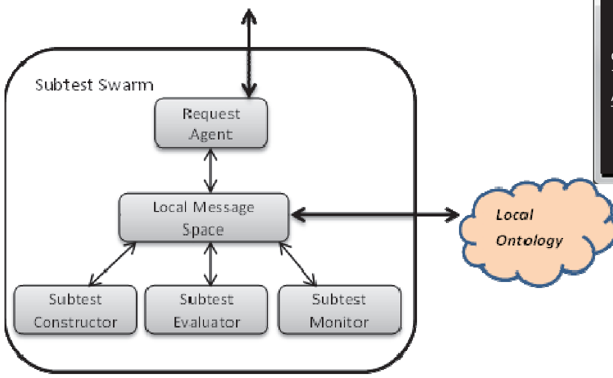

Figure 6: Agents Composition in a Subtest Swarm.

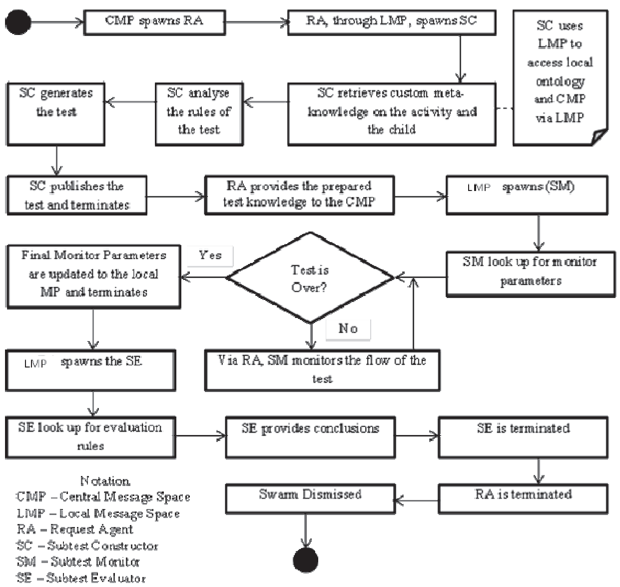

Figure7: Abstract process Flow in a Subtest Swarm During a sub test.

C. Central Message Space, Communication, and Other Special Swarms

Central Message Space is the heart of this agent network through which the swarms exchange messages back and forth. Central Message Space itself has Request Agents to listen to incoming messages from out world – the web service agent, a local message space for maintaining the communication inside this swarm of agents and resource agents for processing work specific for the central system (Course Conductor, Class Admin, and General Evaluator) and for redirecting the messages back and forth via the request agents to destination swarms. The following figure shows the admin information screen of Central Message Space which is updated constantly for troubleshooting and maintenance.

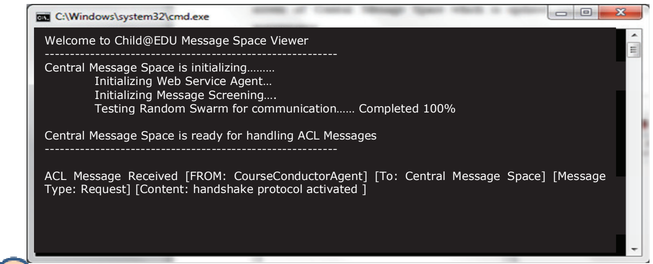

Figure8: central Message Space Message Viewer

The communication between agents happens in the means of ACL messages. ACL messages define a common standard for all the agents to communicate with each other without proposing additional overhead for the developer.

The other two agents: course conductors and general evaluators have been implemented as straight forward as the resource agents of central message space. Especially the general evaluators communicate with Subtest swarms through central message space to retrieve evaluations from each of the carried subtests.

The evaluation rules are derived from WISC-IV specification [1]. Few important rules were stated before and it is recommended that the readers of this paper follow the WISC-IV specification thoroughly as the ontologies model the rules and conditions of WISC-IV as they are stated in that documentation.

D. Screenshots of Graphical User Interfaces

Figure9: GUI screenshots of when a child involves in a writing activity

Figure10: GUI screenshots of when a child involves in a reading activity

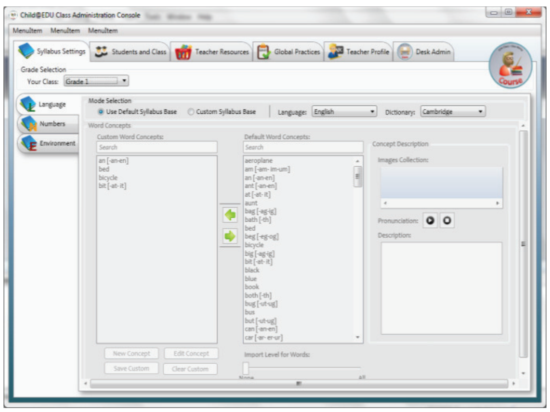

Figure11: Administration Console for Teachers

Figure12: Home Page of the web site

7. Evaluation

The functionality and the quality of Expert Agents Module have been tested in the general testing means of CHILD@EDU system prototype. The testing carried out under the evaluation can be divided in to mainly 4 categories. They are as follows.

i. Unit Testing: These tests have been carried out in programming level of the prototype system to ensure a reliable screening of users to determine the final outcome of the users
ii. Integration Testing: Testing application layer and user interfaces separately.
iii. Functional/System Testing: Testing overall system requirements.
iv. Acceptance Testing: User perspective of the system's quality.

Being Specific to Expert Agents Module and for testing Java code, JUnit 4.x has been used.A large number of Unit test cases have been used in every part of the module to ensure higher quality in unit level.

The best way of assuring the quality of Expert Agents Module was to test it as a whole unite through Integration testing. Integration testing has been carried out while fixing different modules together to form up the prototype of Child@EDU. Especially, when integrating different layers different strategies have been used. The most significant of all is the integration of Expert Agents Module with the web service.

Figure13: Web Service Tester Interface

In Summary, The importance of this research and development project is that it has also run a real acceptance test using children of related samples of interests. The quality of the analysis of the inputs and the produces results clearly reflect the quality of the Expert Agents Module. In other worlds, the result of the acceptance test of CHILD@EDU is a good determinant of the quality of its Expert Agents Module. Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV) has been a worldwide standard testing mechanism for children's learning and intelligence abilities.Its specification comes with proven reliability and dependability. The following table shows the default WISC-IV classification of children depending on the general scores of all tests for WISC-IV [1, 3].

Table 1: Traditional Descriptive System for the WISC-IV

Traditional Descriptive System for the WISC-IV	
Standard Score Range	**Description of Performance**
130 and above	Very Superior
120 to 129	Superior
110 to 119	High Average
90 to 109	Average
80 to 89	Low Average
70 to 79	Borderline
69 and below	Extremely Low

As CHILD@EDU has also adopted this evaluation mechanism, the user tests have been carried out involving 25 children. First, the children were insisted to face three consecutive testing cycles of WISC-IV [1] manual testing. Then the same sample of children was driven to face CHILD@EDU primary education platform on which the tests were run cognitively. Table 2 and Table 3summarize the results.

It was clearly visible that during the first cycle of testing in CHILD@EDU platform the children clearly had a negative deviation. This was due to the fact that the new environment of testing made a mental retaliation and a sudden shock in them. However, during the third cycle, the effect was very similar to WISC-IV manual testing [1, 3]. Thus, it can be concluded that CHILD@EDU with proper adaption to the system can function almost as the manual way speeding up the process and effectively utilizing the resources.

Table 2: WISC-IV manual testing

WISC-IV Manual Testing on 25 Children							
	Very Superior	**Superior**	**High Average**	**Average**	**Low Average**	**Borderline**	**Extremely Low**
Cycle 1	1	2	4	8	5	3	2
Cycle 2	1	2	5	7	5	4	1
Cycle 3	1	2	6	7	5	3	1

Table 3: CHILD@EDU Testing

CHILD@EDU Testing on the same 25 Children							
	Very Superior	**Superior**	**High Average**	**Average**	**Low Average**	**Borderline**	**Extremely Low**
Cycle 1	0	2	2	7	7	4	3
Cycle 2	0	1	6	6	5	5	2
Cycle 3	1	3	5	6	6	3	1

In addition to this, a printed questioner was distributed among a sample of teachers numbered 20. In summary, 80% of the teachers agreed that CHILD@EDU can become a very useful tool for primary education. Moreover, the test results clearly have shown that the results obtained through the process that extended the framework is accurate, complete, and robust.

8. Limitations and Further Work

A. Limitations of Expert Agents Module

CHILD@EDU[11] as a digital knowledge system in a very sensitive domain has faced many challenges during the design time as well as in the implementation. Especially, the following limitations can be noticed in its Expert Agents Module.

- ***Strongly Coupled with WISC-IV:***WISC-IV is a widely used standard for modeling primary education activities and evaluating children. Yet, it is neither the only one nor the one used by everyone. CHILD@EDU agents are, more or less, WISC-IV agents. Therefore the approach propagates limitation in flexibility of using other standards.
- ***Ontologically Static Agents:***The knowledge structures of these expert agents are static whereas their knowledge on those static structures increases with the time. This aspect limits the achievement of full dynamicity of agents. If the agents were fully dynamic (in contrast to being partially dynamic) and with fully learning capacity (in contrast to partially learning agents), the capability of the system could have reached further heights.
- ***Static and Strong Dependency on JADE:*** Currently CHILD@EDU Expert agents solely run on JADE. Therefore the limitations that jade faces in terms of memory management, capacity handling, and web service connectivity, may also affect CHILD@EDU expert agents and the swamp expansion. Especially, CHILD@EDU implements its own web service access library in order support the complex tasks of its users, which communicates with JADE in indirect ways.
- ***Agents to Support Teachers, Parents, and other Parties:*** CurrentlyCHILD@EDU does employee agents specifically as assistants for the teachers. Currents agents are just friends of the Children and the workforce of the system. Therefore, as of now, the solution limits theabilities of other users over this knowledge system.
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B. Further workof Expert Agents Module

CHILD@EDU's capabilities and capacity solely depend on its Expert Agents Module. Further work of this module may reflect back as an increment of the efficiency and effectiveness in the processes of primary education. As of now, it completely focuses on children and providing them an immersive experience in learning while silently evaluating them. The following list is suggested as further work of this module.

- ***Freelancing Agents:***All the agents in CHILD@EDU expert agents' pool is allocated a specific task. As further development of the pool, it is suggested to include additional agents to support dynamic miscellaneous functions.
- ***Intelligent Agents to Support Speech-to-Images Graphical Guidance:*** With the power of flexibility built-in to CHILD@EDU and its Expert Agents Module, it can be further developed as means of add-ons. This suggesting feature is one such add-on that can heavily heighten the learning experience of children. Respecting the famous quote "A picture worth a thousand of word", it is suggested to visualize the speech of teacher and even child when engaged in various activities.
- ***Agents to Support Teachers:***As the closest next step, it is recommended to include agents as assistants to teachers adhering to WISC-IV standards.
- ***Agents with Common Basic Fully Dynamic Ontology:***Having a basic ontology, with programming language specific technologies like Reflection, can be used to create fully dynamic agents: agents that change its own knowledge definition and grow intelligently.

9. Conclusion

CHILD@EDUis a good solution to some critical problems faced in Primary Education. It was said that only a specialized approach can be adapted to solve the following issues found in modern primary education systems.

- One Teacher-One Child education is not being globally possible
- All Teachers or parents are not being experts in child psychologists or physiatrists.
- Effective report generation of a child's educational attributes
- Supporting Effective Student Centric Teaching
- Integrating Parents, Education Institute, and Children
- System of Systems is needed for efficient government decision making

The challenge of addressing all these issues is to find a modern-day technology approach to produce a system which contains entities that may work is met effectively by CHILD@EDU by using the powerful ***multi-agent technology*** [11]. It introduces the agency of expert humans in specific micro elements of an effective learning of a primary child in software environment, In simple words, software agents function as unique expertise on 5 elemental characteristics of effective primary learning with reference to Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV) Standard [1, 3]. Moreover, it adopts an evaluation mechanism from WISC-IV to effectively monitor and evaluate the learning and intelligence attributes of children.

CHILD@EDU Expert Agents module is where it facilitates the inhabitance of distributed work-delegated, agents each handling an atomic task. These tasks ultimately help the system to generate educational and testing activates for the children, monitor them, or evaluate their progress. It is a very effective way of introducing expert computer agency in the field of Primary Education. The robust design of the expert agent module enables fast communication, increased cardinality of work and users, and accurate decision making.

Expert Agents Module too face many limitation inherited by technology as well as by the design itself like any other solution in the world. Out of these, the main attention should be given to develop dynamic learning agents so that the system itself can evolve and expand itself horizontally without external interference. Further, freelancing agents in addition to the agents that are strongly coupled with WISC-IV could increase the systems performance drastically.

CHILD@EDU could overcome most of the problems that could be found in the compared systems stated in Section II. Especially, with expert psychological focus on each child and by offering personalized/ customized course in general classroom, it demonstrates an immersive capability of working with sensitive aspects of children than the mentioned systems while effectively evaluating and producing reports. Unlike most of those systems, CHILD@EDU supports the primary education system for seeing the true attributes of children and enforces better and effective decision making.

Acknowledgment

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