

Modeling Child Development Factors for the Early Introduction of ICTs in Schools

K. E. Oyetade, S. D. Eyono Obono

Abstract—One of the fundamental characteristics of Information and Communication Technology (ICT) has been the ever-changing nature of continuous release and models of ICTs with its impact on the academic, social, and psychological benefits of its introduction in schools. However, there seems to be a growing concern about its negative impact on students when introduced early in schools for teaching and learning. This study aims to design a model of child development factors affecting the early introduction of ICTs in schools in an attempt to improve the understanding of child development and introduction of ICTs in schools. The proposed model is based on a sound theoretical framework. It was designed following a literature review of child development theories and child development factors. The child development theoretical framework that fitted to the best of all child development factors was then chosen as the basis for the proposed model. This study hence found that the Jean Piaget cognitive developmental theory is the most adequate theoretical frameworks for modeling child development factors for ICT introduction in schools.

Keywords—Child development factors, child development theories, ICTs, theory.

I. INTRODUCTION

DESPITE the varying arguments about the presence of technology in schools, there has been an increasing use of ICT in schools for teaching and learning opening us up with new choices, challenges, and opportunities. According to [2], ICT generally relates to those technologies that are used for accessing, gathering, manipulating and presenting or communicating information. These includes radios, television, desktop and laptop computers, software, peripherals and connections to the Internet that are intended to fulfil information processing and communications functions [3], [5]. The following extracts from [3]-[5], [8]-[11], [30] highlight the benefits of ICT in education:

- A tool for supporting young children's learning and development
- ICTs provide a context for collaboration, co-operation, and positive learning experiences between children, or between children and adults.
- ICTs provide a variety of ways for children to weave together words, pictures, and sounds, thereby providing a range of ways for children to communicate their ideas, thoughts, and feelings.

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- Assistive/adaptive ICTs can reduce barriers to participation for children with special physical or learning needs.
- Children and practitioners use ICT together to document and reflect on children's learning, or to share children's learning with parents, or other practitioners.
- Children and practitioners use ICT to communicate or exchange ideas or information with other practitioners, parents, or researchers.
- It eliminates barriers to education for students and for teachers.
- It eliminates geographic barriers for students to be able to access knowledge resources from any location.
- Allows use of new methods of education.

A. Problem Statement

Regardless of the above highlighted benefits and pervasiveness of ICTs in schools, parents, teachers, as well as stakeholders have questioned its relationship with the cognitive, emotional, social, and developmental needs of young children [15], which have raised certain specific concerns. Some of these concerns often raised in relation to ICT use are highlighted by [13], [14], [30] below:

- Harmful physical effects of children's prolonged computer use
- Negative impacts on children's social development
- Educational concerns that computer use can interfere with aspects of children's cognitive development
- Children's exposure to unsuitable content, such as material of a sexual or violent nature, or containing inappropriate gender, cultural, or social stereotypes
- Concerns that ICT might displace other important learning and play activities
- Physical health and safety concerns
- Concerns about children's learning, cognitive, social, and emotional development such as isolation from social interaction in learning and play, or that violence in computer games could encourage aggressive behavior.

B. Aim and Objectives

The study aims to model child development factors affecting the early introduction of ICTs in school. The choice of child development theory as the main theme of this research can be justified by the answering the question "From which age can ICTs be safely used by children for various application domains despite its well-known benefits?". It is possible that by studying child development theory in relation to the concerns on the presence of ICTs in schools, existing knowledge on child development can be enriched. Child

development factors model to be proposed by this research is expected to be based on a sound child development theoretical framework. Therefore, the two main objectives of this research are to investigate existing child development theoretical frameworks, and to identify child development factors.

II. LITERATURE REVIEW

Readers are invited to the next section of this paper on its research design where they will be informed that the results of this paper are obtained from a two-stage literature review.

III. RESEARCH DESIGN

This research is designed in the form of a literature review. A first literature review will be conducted to identify child development theories in general. A second literature review will be conducted to identify child development factors affecting the early introduction of ICTs in school. The authors will then attempt to fit these factors into each child development theoretical framework, and then choose the best framework using factors fitness as comparison criteria.

A. Child Development Theories

The result of the literature review conducted in this study of early childhood development theories reveals that there are four existing development theoretical frameworks: the attachment developmental theory, cognitive developmental theory, behaviourist developmental theory, and ecological developmental theory [1].

1. Attachment Developmental Theory

The attachment theory is based on the emotional and healthy attachment that develops between children and their parent or caregivers [1], [12]. According to the attachment theory (Fig. 1), the attachment of children to their parent or caregivers affect the development, the behaviour or the personality of these children in the sense that it structures their brains for later successes and develops in them the confidence to explore the world and to create relationships with others [6], [7], [12], [18].

2. Cognitive Developmental Theory

Cognitive development is concerned with the relationship between the changes that occur in an individual's cognitive structure, abilities, and processes as well as the development of that individual [17], [24]. Influential theories of cognitive development include the stage theory of Jean Piaget and the sociocultural theory of Lev Vygotsky.

Jean Piaget Cognitive Developmental Theory: Piaget based his theory on the understanding that children create and construct their own ideas and knowledge from their own life discoveries and experiments through assimilation (fitting new experiences or knowledge into an existing mental structure) and accommodation (adapting new information and automatically applying them when new information is added to the old schema) [1], [17], [21], [26]. Cognitive development of children involves four stages (Fig. 2): sensorimotor,

preoperational, concrete operational and formal operational and each stage provide children with new intelligent abilities towards an improved understanding of the world [29].

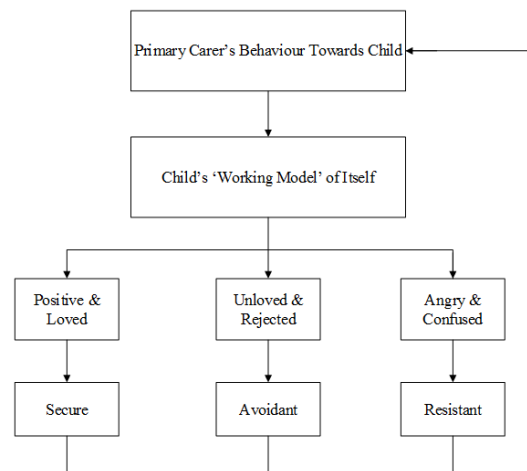


Fig. 1 Attachment development model

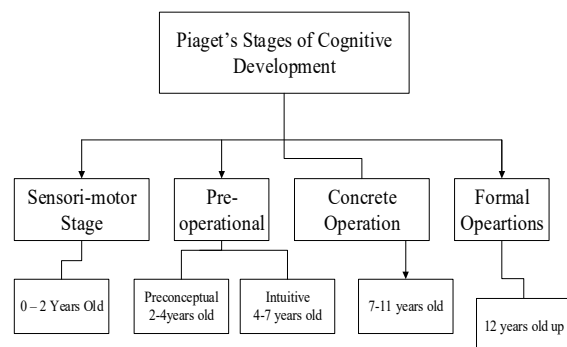


Fig. 2 Piaget's developmental model

Lev Vygotsky Cognitive Developmental Theory: Vygotsky's theory is concerned with the role of social interactions and culture on human development and learning [19], [25], [26], [28]. This theory states that children make use of languages to establish social interactions with key figures in their lives such as parents, peers, teachers, and other adults; and these interactions profoundly shape their mental processes, intellectual development and their interpretations of the world, [24], [25], [27]. Vygotsky defined the Zone of Proximal Development (ZPD) as the need for a child to be assisted for certain aspects of his or her development by interacting with others does which does not exclude the fact that there are other aspects of development that can be achieved by the child without any external assistance (Fig. 3). Vygotsky believed that both biological development and cultural experiences influenced children's ability to think and learn.

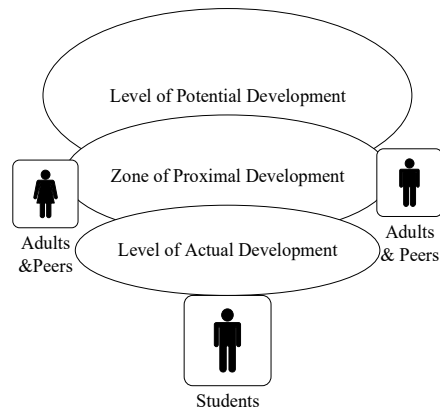


Fig. 3 Vygotsky's zone of proximal development [25]

3. Behaviourist Developmental Theory

Behaviourist theory is a theory that posits that most life events are shaped by the environment and believes learning is gradual and continuous [1]. The development of a child depends on his or her interactions with his or her environment. Adults play an important role in these interactions of the child with his and her environment in the sense that children learn from the behaviour of adults [16].

4. Ecological System Developmental Theory

Ecological system theory hypothesizes that the development of a child is influenced by the reciprocal relationship between him or her and the many institutions and settings in his or her surroundings (the family, the community, the school, the political system) [20], [23]. This component can be classified into four layers (Fig. 4) hereby listed from the closest to the farthest from the child: the microsystem, mesosystem, exosystem, macrosystem, and the chronosystem [20]. This theory also emphasizes a balance between nature and nurture. The child is placed in the middle of concentric factors which all influence the child. Emphasis is placed both on environment and heredity.

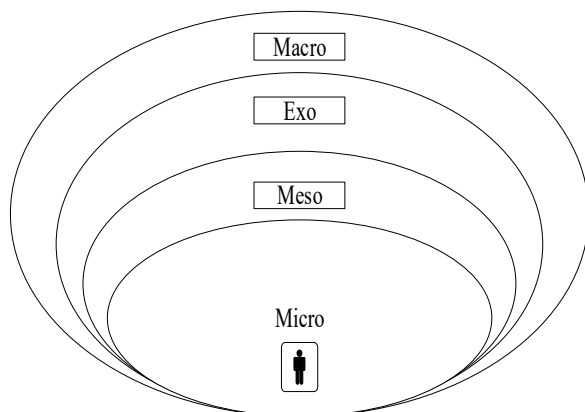


Fig. 4 Bronfenbrenner's bio-ecological model of child development [23]

B. Child Development Factors for ICT Introduction in Schools

When considering ICT introduction in schools from the perspective of child development, the following factors were derived: handling more than one concept at a time, applying logic to classify object, analyzing hypotheses using deductive reasoning and abstract thinking, ability to handle information, ability to develop physical fitness, sharing sensitive information, dealing with conflicts and behavioural challenges, dealing with information on moral issues, ability to differentiate themselves, auto-assessing their actions..

TABLE I
CHILD DEVELOPMENT FACTORS FOR ICTS INTRODUCTION IN SCHOOLS

	Factors	References
B1	Handling more than one concept at a time	[22]
B2	Apply logic to classify object	[17], [26]
B3	Analyzing hypotheses using deductive reasoning and abstract thinking	[25], [27], [29]
B4	Ability to handle information	[20], [27], [29]
B5	Ability to develop physical fitness	[18], [22]
B6	Sharing sensitive information	[16], [29]
B7	Dealing with conflicts and behavioural challenges	[16], [20], [23]
B8	Dealing with information on moral issues	[20], [22], [23]
B9	Differentiating themselves as individuals	[6], [29]
B10	Auto-assessing their actions	[1], [18]

1. Handling More than One Concept at a Time

According to [22], children begin to handle more than one concept at a time as early as age 3-6 years, ICTs can be therefore be introduced at school in order to optimally assist learners to handle many task at a time .

2. Apply Logic to Classify Object

References [1], [26] found that ICTs can be introduced at school in order to optimally assist learners on how to apply logic to classify objects and ideas based on hands on strategies in connecting ideas.

3. Analyzing Hypotheses Using Deductive Reasoning and Abstract Thinking

References [25], [27], [29] reports that ICTs can be in introduced in schools in order for them to optimally assist learners analyze hypotheses using abstract thinking and deductive reasoning by introducing and reinforcing alternatives explanations for interpreting events that confirm their beliefs.

4. Ability to Handle Information

A major advantage to introducing ICTs early in school is the reasons found by [27], [29] which states that ICTs can be useful in schools in order to optimally assist learners on how to receive, process, remember, and present information.

5. Ability to Develop Physical Fitness

Results from [18] reveals that ICTs can be introduced in schools in order to optimally assist learners on how to develop physical fitness including during puberty by providing

information about their physical changes and necessary support.

6. Sharing Sensitive Information

According to [16], [29], ICTs is beneficial when introduced early in school in order to optimally assist learners on how to handle sensitive information with others.

7. Ability to Deal with Conflicts and Behavioural Challenges

References [16], [20], [23] found that ICTs is beneficial in school in order for them to optimally assist learners on how to deal with conflicts and behavioural challenges.

8. Ability to Deal with Moral Issues

References [20], [23] found that ICTs is beneficial in school in order for them to optimally assist learners on how to seek information on their actions as well as deal with moral issues such as sex, abortion, etc.

9. Ability to Differentiate Themselves

According to [6], [29], ICTs can be introduced in school in order for them to optimally assist learners on how to differentiate themselves as individuals.

10. Ability to Auto-Assess Their Actions

According to [1], [18], ICTs is beneficial at school in order for them to assist optimally learners to auto-assess their actions.

IV. RESULTS

This section presents the results of this research in terms of the identification of existing child development, and of child development factors for ICT introduction in school. This section ends with the presentation of the fitness of the above mentioned factors in the identified theoretical frameworks, as a step towards the selection of the most appropriate theoretical framework.

A. Matching Factors with Theories

This section presents how the above identified child development factors for ICT introduction in schools were fitted in the child development frameworks described earlier.

1. Attachment Developmental Theory

Fig. 6 shows that it is possible to model child development factors according to the attachment developmental theory. However, the classification of the following child development factor is questionable: sharing sensitive information, ability to deal with conflicts and behavioural challenges, and the ability to deal with moral issues.

2. Jean Piaget Cognitive Developmental Theory

Fig. 7 shows that it is possible to model child development factors according to Piaget's developmental theory.

3. Lev Vygotsky Cognitive Sociocultural Developmental Theory

Fig. 7 shows that it is possible to model child development factors according to Vygotsky sociocultural theory. However, the classification of the following child development factor is questionable: ability to develop physical fitness and sharing sensitive information.

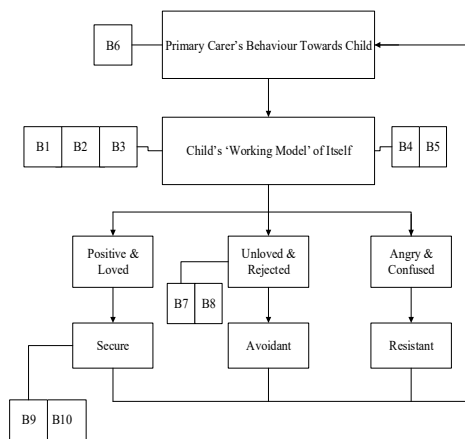


Fig. 5 Attachment child development factors for ICT introduction

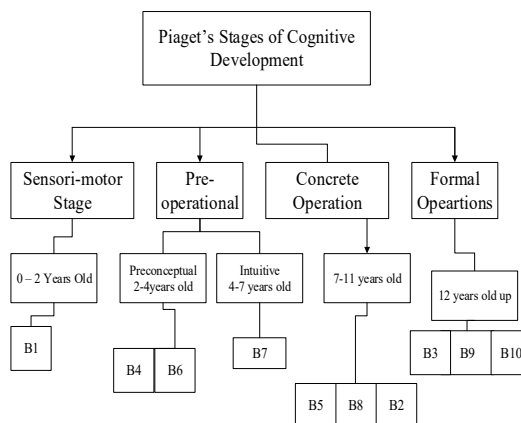


Fig. 6 Piaget's based child development factor for ICT introduction

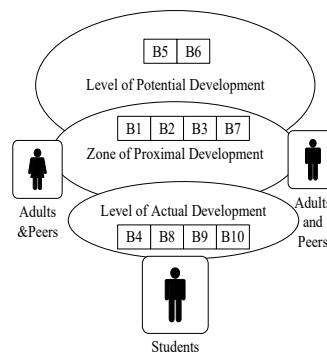


Fig. 7 Vygotsky's based child development factor for ICT introduction

4. Ecological Developmental Theory

Fig. 8 shows that it is possible to model child development factors according to the ecological developmental theory. However, the classification of the following child development factor is questionable: the ability to handle information.

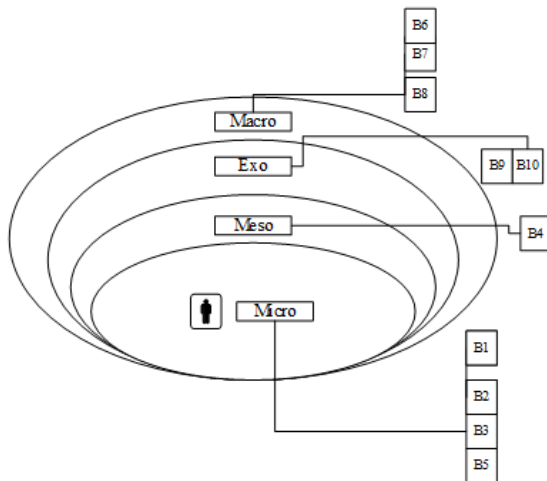


Fig. 8 Ecological based child development factor for ICT introduction

B. Modelling Child Development Factors

When matching child development factors for ICT introduction in schools with existing child development theories, the conclusion was reached that child development factors for ICT introduction can be adequately modelled using Piaget's developmental theory. This is possible because this theory involves the stages of life development that provides youngsters with new intelligent abilities towards an improved understanding of the world. Bearing in mind this understanding, ICTs can be introduced at different developmental stage for children's learning tasks that are suitable for their stage of thinking.

V. DISCUSSION AND CONCLUSION

In this paper, a review of existing child development theories was conducted, followed by a review of child development factors. These child development factors were then matched with the child development theories to identify the best child development theories for ICT introduction in schools. According to the results of this paper, Jean Piaget's developmental theories are the most suitable theories for the modeling of child development factors. The main contribution of this paper resides in the fact that it provides evidence on the suitability of existing child development theories for the modeling of child development factors for ICT introduction in schools, instead of just choosing one theory over another as usually done in other existing research. Future research will attempt to empirically validate the theoretical models proposed by this paper.

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